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WASTEWATER MANAGEMENT ALTERNATIVES FOR THE CLEVELAND - AKRON, T--ETC(U)
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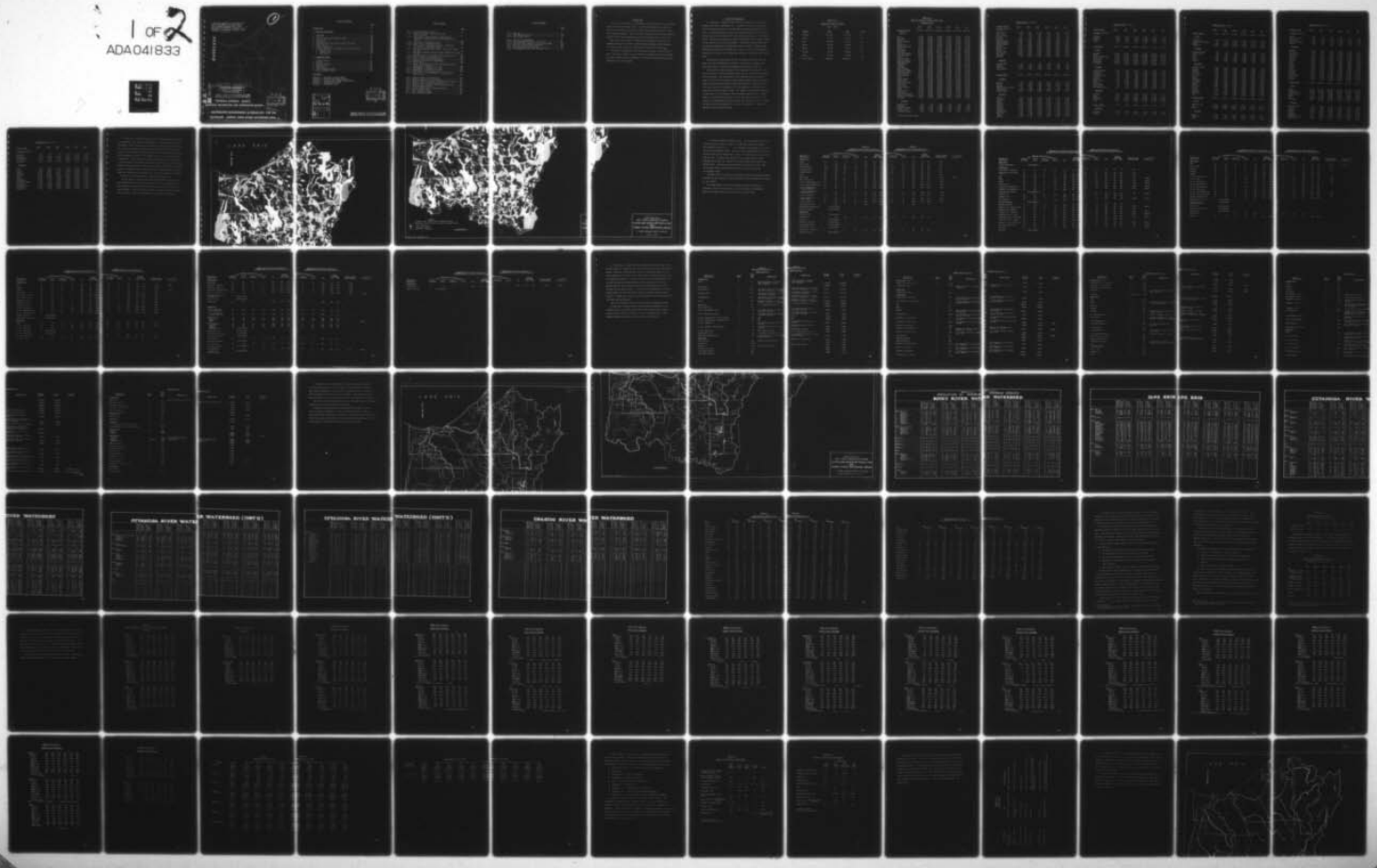
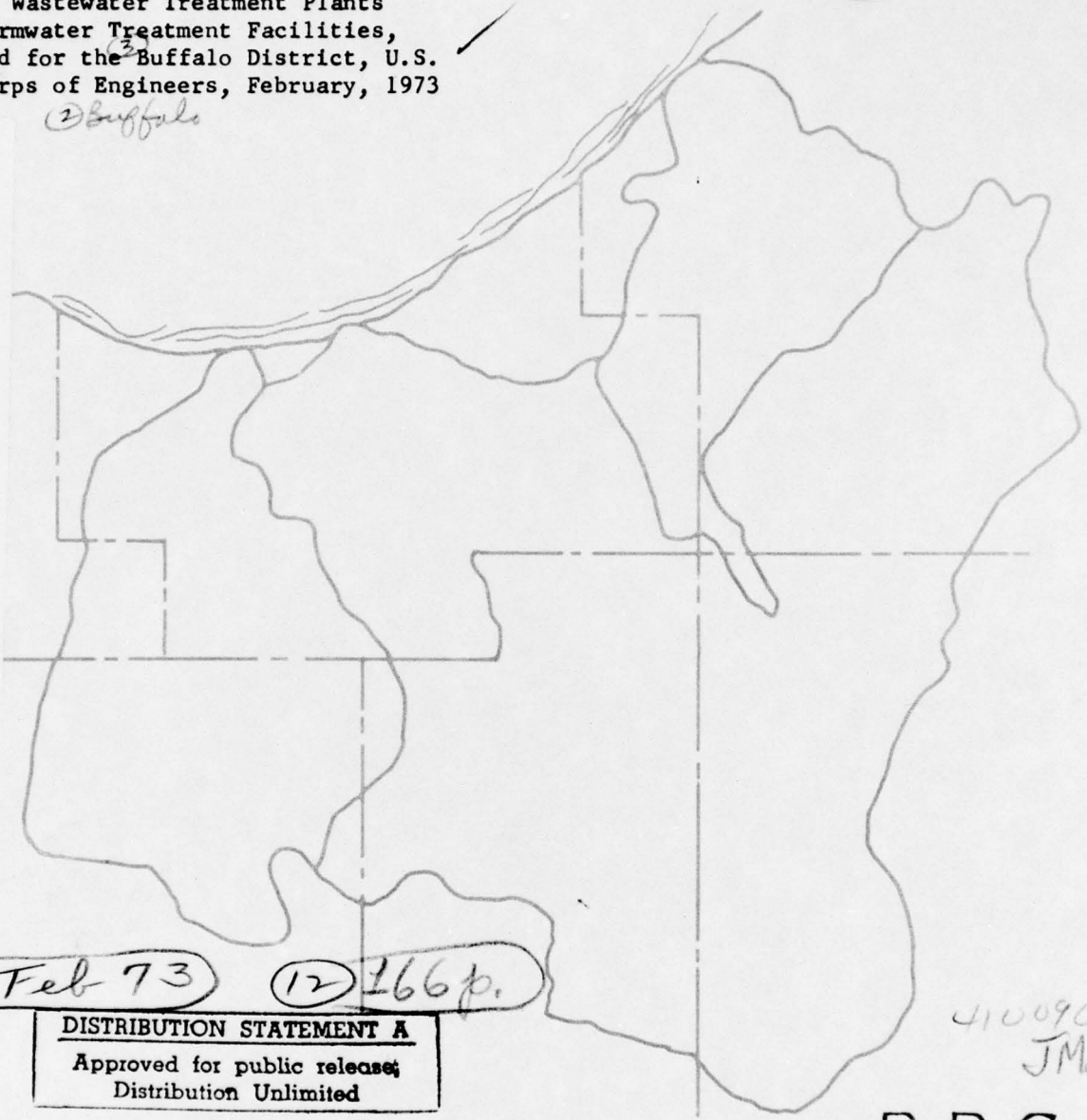


A Specialty Appendix on the Design and Cost of Wastewater Treatment Plants and Stormwater Treatment Facilities, prepared for the Buffalo District, U.S. Army Corps of Engineers, February, 1973



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TECHNICAL APPENDIX - PHASE I.

MUNICIPAL WASTEWATER AND STORMWATER RUNOFF.

WASTEWATER MANAGEMENT ALTERNATIVES FOR THE CLEVELAND - AKRON, THREE RIVERS WATERSHED AREA.

HAVENS AND EMERSON LTD. CONSULTING ENVIRONMENTAL ENGINEERS

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INTRODUCTION

This Survey Scope Study is a continuation of the preliminary work performed under the Feasibility Study in 1971. The Cleveland-Akron area was chosen by the Corps of Engineers as one of five pilot areas in which to develop a wastewater management program. Three consulting engineering firms have been selected to work with the Corps in developing the Cleveland-Akron Survey Scope Study.

This report covers Phase I of the study, and identifies the wastewater management problem with respect to domestic and stormwater runoff wastewater as it exists today and as it is anticipated to exist in the future.

This data is presented by items as described in Phase I of the scope of work. This Phase I report is in the nature of a progress report, and although the data presented herein is complete, it is subject to minor modification and correction in the final report.

A - MUNICIPAL WASTEWATER

1. Demography - Population projections have recently been made for the Northeast Ohio Water Development Plan. In general, this data provided the source of population figures, which have been reviewed and adjusted in a few areas. The 1970 population estimates were adjusted to the 1970 census data, and the projections were made by the same percentage increases as in the data source. Several areas were varied from the data source to more closely conform to the expectations of the local planners. Specifically, Medina County and the central Cuyahoga Basin were adjusted upwards to reflect a higher growth pattern than projected in the NEOWD Plan. Table A-1-2 lists the population projections by county, city, village, and townships by decade through the year 2020.

The population projections were made in conjunction with the land use maps, and could be substantially altered in the future by a change in the growth philosophy of the local governmental bodies affecting land use.

The 1960-1970 population change in Ohio amounted to an increase of 9.7%. This entire gain was due to natural increase, that is, the difference between births and deaths. The net migration, (the difference between those who moved in and those who moved out of Ohio) between 1960 and 1970 was a negative number, meaning that more people moved out than moved in. Whereas Ohio as a whole experienced a net increase of 9.7%, the counties in the study area exhibited a much more dramatic change. For example, Portage County increased in population by 37.1%, making it the most rapidly growing county. Geauga County was second with an increase of 32.7%; Lake County was third with an increase of 32.6% and Medina County was sixth with a growth of 26.4%. Cuyahoga and Summit Counties had growths of 4.5% and 7.6% respectively. Table A-1-1 tabulates these population changes.

TABLE A-1-1

POPULATION CHANGE BY COUNTY

(1960 - 1970)

County	1960	1970	% Gain
Cuyahoga	1,647,895	1,721,404	4.5
Geauga	47,573	63,125	32.7
Lake	148,700	197,154	32.6
Lorain	217,500	256,843	18.1
Medina	65,315	82,583	26.4
Portage	91,798	125,868	37.1
Summit	513,569	552,498	7.6
Ohio (State)	9,706,397	10,652,017	9.7

TABLE A-1-2

CORPS OF ENGINEER'S SURVEY SCOPE STUDY

POPULATION DATA

	1970*	1980	1990	2000	2010	2020
Cuyahoga County	1,721,404	1,842,070	2,192,050	2,393,720	2,519,800	2,523,000
Cities						
Bay	18,163	22,200	24,000	24,100	24,200	24,300
Beachwood	9,631	12,600	15,400	17,400	18,500	18,600
Bedford	17,552	20,500	23,900	26,401	27,800	27,800
Bedford Heights	13,063	19,200	24,400	28,100	30,100	30,300
Berea	22,396	27,600	33,000	36,900	39,100	39,100
Brecksville	9,137	14,200	18,200	20,300	22,100	22,600
Broadview Heights	11,463	15,600	19,300	21,900	23,400	23,600
Brooklyn	13,142	15,800	18,700	20,800	21,900	21,900
Brook Park	30,774	42,900	54,100	62,000	66,400	66,900
Cleveland	750,903	738,900	788,400	833,100	856,600	846,000
Cleveland Heights	60,767	66,200	74,200	80,500	83,900	83,500
East Cleveland	39,600	44,100	50,200	54,900	57,400	57,200
Euclid	71,552	84,500	98,400	108,700	114,400	114,300
Fairview Park	21,681	27,000	32,200	36,000	38,000	38,100
Garfield Heights	41,417	47,200	54,200	59,500	62,400	62,300
Highland Heights	5,926	8,300	10,300	11,800	12,600	12,700
Independence	7,034	9,000	12,000	15,000	18,000	21,000
Lakewood	70,173	79,300	90,800	99,500	104,300	104,000
Lyndhurst	19,749	23,500	27,500	30,500	32,100	32,100
Maple Heights	34,100	39,100	45,000	49,400	51,800	51,700
Mayfield Heights	22,139	29,200	35,800	40,500	43,100	43,300
Middleburg Heights	12,367	16,500	20,300	23,000	24,500	24,600
North Olmsted	34,861	49,000	61,500	70,300	75,200	75,700
North Royalton	12,807	16,100	19,300	21,700	23,000	23,000
Parma	100,216	120,000	141,200	156,800	165,300	165,400
Parma Heights	27,192	34,000	41,200	46,400	49,400	49,400
Pepper Pike	5,933	6,500	8,100	9,400	10,900	11,000
Richmond Heights	9,220	12,100	14,900	17,000	18,100	18,200
Rocky River	22,958	28,000	33,200	37,000	39,100	39,200
Seven Hills	12,700	18,300	23,000	26,300	28,200	28,400
Shaker Heights	36,306	39,800	44,900	48,800	50,900	50,700
Solon	11,519	15,700	19,500	22,200	23,600	23,800
South Euclid	29,579	33,800	38,800	42,600	44,600	44,500
Strongsville	15,182	20,400	25,300	28,700	30,600	30,800
University Heights	17,055	18,000	20,300	22,000	23,000	22,800
Warrensville Heights	18,925	25,600	31,600	35,900	38,300	38,500
Westlake	15,686	22,000	29,000	36,000	44,000	50,000
Villages						
Bentleyville	338	400	400	500	500	500
Bratenahl	1,613	3,000	5,000	6,000	7,000	8,000
Brooklyn Heights	1,527	1,700	1,900	2,100	2,200	2,200
Chagrin Falls	4,848	6,200	7,400	8,300	8,800	8,900
Cuyahoga Heights	866	1,000	1,100	1,200	1,200	1,200

*Actual 1970 Census Data

POPULATION DATA (Cont'd.)

Cuyahoga County	1970	1980	1990	2000	2010	2020
Villages (Cont'd.)						
Gates Mills	2,378	3,000	3,700	4,100	4,400	4,400
Glenwillow	526	600	700	700	700	700
Hunting Valley	673	1,200	2,000	2,400	2,800	3,200
Linndale	145	200	200	200	200	200
Mayfield	3,550	4,800	5,900	6,700	7,200	7,200
Moreland Hills	3,000	3,900	4,500	5,000	5,300	5,300
Newburg Heights	3,396	3,600	4,100	4,400	4,600	4,500
North Randall	1,212	1,600	2,000	2,300	2,400	2,500
Oakwood	3,127	3,000	3,300	3,400	3,500	3,400
Olmsted Falls	2,504	3,000	3,500	3,800	4,000	4,000
Orange	2,112	2,400	2,800	3,000	3,200	3,200
Valley View	1,422	2,000	2,400	3,000	3,500	4,000
Walton Hills	2,508	3,500	4,200	4,700	5,200	5,500
West View	2,523	3,500	4,300	4,900	5,200	5,300
Woodmere	976	1,500	1,900	2,200	2,400	2,400
Townships						
Chagrin Falls	84	170	250	320	400	500
Olmsted	6,318	5,800	5,800	6,000	6,000	6,000
River Edge	632	600	600	600	600	600
Warrensville	2,160	2,000	2,000	2,000	2,000	2,000
Geauga County	63,125	90,300	126,400	166,900	204,000	230,600
Villages						
Aquilla	389	600	800	1,000	1,200	1,400
Burton	1,214	1,600	2,000	2,600	3,100	3,500
Chardon	3,991	5,500	7,500	9,800	11,900	13,500
Hunting Valley (Part)	124	200	300	300	400	400
Middlefield	1,726	2,500	3,500	4,500	5,500	6,200
South Russell	2,673	4,500	6,800	9,200	11,400	13,100
Townships						
Auburn	1,517	2,300	3,200	4,200	5,100	5,800
Bainbridge	7,038	10,000	14,500	19,400	23,700	26,800
Burton	2,366	3,400	4,800	6,200	7,600	8,600
Chardon	3,180	4,500	6,300	8,300	10,200	11,500
Chester	10,400	14,800	20,500	27,100	33,000	37,300
Claridon	2,124	3,000	4,200	5,600	6,800	7,700
Hambden	2,500	3,500	4,900	6,500	8,000	9,000
Huntsburg	1,792	2,600	3,600	4,700	5,800	6,500
Middlefield	2,738	3,900	5,400	7,200	8,800	9,900
Montville	1,307	1,900	2,600	3,400	4,200	4,700
Munson	3,569	5,100	7,100	9,400	11,500	12,900
Newbury	4,038	5,700	8,000	10,600	12,900	14,600

POPULATION DATA (Cont'd.)

Geauga County	1970	1980	1990	2000	2010	2020
Townships (Cont'd.)						
Parkman	2,084	3,000	4,200	5,500	6,700	7,600
Russell	4,669	6,700	9,300	12,300	15,000	17,000
Thompson	1,834	2,600	3,600	4,800	5,900	6,600
Troy	1,652	2,400	3,300	4,300	5,300	6,000
Lake County	197,154	268,600	369,200	464,100	547,100	600,300
Cities						
Eastlake	19,690	26,600	41,800	53,600	63,800	70,400
Mentor	36,900	56,300	80,400	103,500	123,600	136,600
Mentor-on-the-Lake	6,517	10,500	15,400	20,000	24,000	26,500
Painesville	16,536	19,300	23,900	28,700	33,000	35,800
Wickliffe	21,354	29,400	40,000	50,500	59,600	65,500
Willoughby	18,634	24,700	32,900	41,000	48,200	52,800
Willowick	21,237	26,900	34,800	49,800	49,900	54,500
Villages						
Fairport Harbor	3,665	3,700	4,100	4,600	5,100	5,400
Grand River	613	800	1,100	1,400	1,700	1,800
Kirtland	5,530	7,200	9,500	11,700	13,700	15,000
Kirtland Hills	452	600	800	1,000	1,200	1,300
Lakeline	223	300	400	500	600	700
Madison	1,678	2,300	3,000	3,800	4,400	4,900
North Perry	851	1,200	1,600	2,000	2,300	2,500
Perry	917	1,300	1,700	2,100	2,500	2,700
Timberlake	964	1,300	1,800	2,200	2,600	2,900
Waite Hille	514	700	1,000	1,200	1,400	1,500
Willoughby Hills	5,247	7,000	9,400	11,700	13,800	15,100
Townships						
Concord	5,948	8,100	11,000	13,700	16,000	17,400
Leroy	1,759	2,400	3,200	4,000	4,700	5,100
Madison	12,455	16,900	22,900	28,600	33,400	36,500
Painesville	10,870	14,800	20,000	24,900	29,200	31,800
Perry	4,600	6,300	8,500	10,600	12,400	13,600
Lorain County	7,003	7,500	8,000	8,300	8,400	8,200
Townships						
Columbia	5,738	6,100	6,600	6,800	6,900	6,700
Grafton	1,265	1,400	1,400	1,500	1,500	1,500

POPULATION DATA (Cont'd.)

	1970	1980	1990	2000	2010	2020
Medina County	82,583	120,700	161,400	195,400	228,400	256,100
Cities						
Brunswick	15,852	30,000	38,000	42,000	48,000	56,000
Chippewa-on-the-Lake	341	500	600	800	900	1,000
Medina	10,828	15,800	21,700	27,600	32,600	36,400
Wadsworth	13,142	17,600	23,500	29,500	34,900	38,600
Villages						
Briarwood Beach	508	700	900	1,100	1,400	1,500
Gloria Glens	332	500	600	800	900	1,000
Leroy	715	1,000	1,300	1,700	2,000	2,200
Lodi	2,399	2,900	3,600	4,400	5,100	5,600
Seville	1,400	1,700	2,300	2,800	3,300	3,700
Spencer	758	1,000	1,400	1,800	2,100	2,300
Townships						
Brunswick Hills	2,293	3,200	4,100	5,000	5,900	6,500
Chatman	1,258	1,600	2,200	2,700	3,200	3,600
Granger	2,142	2,700	3,700	4,700	5,500	6,100
Guilford	2,028	2,600	3,500	4,400	5,200	5,700
Harrisville	1,122	1,400	1,900	2,400	2,900	3,200
Hinckley	4,210	5,300	7,300	9,200	10,900	12,000
Homer	845	1,100	1,500	1,800	2,200	2,400
Lafayette	2,465	3,100	4,300	5,400	6,300	7,000
Litchfield	1,332	1,700	2,300	2,900	3,400	3,800
Liverpool	2,826	4,200	6,900	7,800	8,600	9,200
Medina	2,445	4,000	5,300	6,400	7,500	9,000
Montville	2,497	4,000	5,400	6,400	7,400	8,400
Sharon	2,764	3,500	4,800	6,000	7,100	7,800
Spencer	728	900	1,300	1,600	1,900	2,100
Wadsworth	4,371	5,600	7,500	9,500	11,200	12,300
Westfield	1,253	1,600	2,200	2,700	3,200	3,500
York	1,729	2,500	3,300	4,000	4,800	5,200
Portage County	123,078	166,400	221,600	279,800	326,800	357,600
Cities						
Garrettsville	1,718	2,000	2,400	2,900	3,400	3,700
Kent	28,183	40,800	56,100	71,900	85,100	93,700
Ravenna	11,800	14,000	17,300	20,900	24,100	26,100
Villages						
Aurora	6,549	9,700	13,400	17,200	20,400	22,500
Brady Lake	450	600	800	1,000	1,200	1,300
Hiram	1,484	2,100	2,900	3,700	4,300	4,800

POPULATION DATA (Cont'd.)

Portage County	1970	1980	1990	2000	2010	2020
Villages (Cont'd.)						
Mantua	1,199	1,400	1,600	1,900	2,200	2,400
Mogadore (Part)	651	900	1,200	1,500	1,700	1,900
Streetsboro	7,966	10,000	13,100	16,500	19,300	21,200
Sugar Bush Knolls	119	200	200	300	300	300
Windham	3,360	3,100	3,300	3,600	3,900	4,100
Townships						
Atwater	2,408	3,300	4,400	5,600	6,500	7,100
Brimfield	6,721	9,200	12,300	15,500	18,200	19,800
Charlestown	864	1,200	1,600	2,000	2,300	2,600
Deerfield	2,175	3,000	4,000	5,000	5,900	6,400
Edinburg	1,563	2,100	2,900	3,600	4,200	4,600
Franklin	5.839	8,000	10,700	13,500	15,800	17,200
Freedom	1,649	2,300	3,000	3,800	4,500	4,900
Hiram	1,400	1,900	2,600	3,200	3,800	4,100
Mantua	1,199	1,600	2,200	2,800	3,200	3,500
Nelson	1,839	2,500	3,400	4,300	5,000	5,400
Palmyra	1,717	2,400	3,200	4,000	4,600	5,100
Paris	1,400	1,900	2,500	3,100	3,700	4,000
Randolph	4,150	5,700	7,600	9,600	11,200	12,200
Ravenna	8,836	12,100	16,200	20,400	23,900	26,100
Rootstown	6,010	8,200	11,000	13,900	16,200	17,700
Shalersville	4,967	6,800	9,100	11,500	13,400	14,700
Suffield	5,799	7,900	10,600	13,400	15,600	17,100
Windham	1,063	1,500	2,000	2,500	2,900	3,100
Summit County	552,498	640,800	737,700	814,900	860,300	875,300
Cities						
Akron	275,425	293,200	321,200	347,000	361,100	362,800
Barberton	33,052	36,200	40,100	43,600	45,500	45,800
Cuyahoga Falls	49,678	55,900	63,000	69,100	72,400	73,000
Munroe Falls	3,794	5,500	6,800	7,900	8,400	8,600
Norton	12,308	14,400	16,500	18,300	19,300	19,500
Stow	19,847	26,700	32,600	37,100	39,600	40,400
Tallmadge	15,274	19,800	23,900	27,000	28,800	29,200
Villages						
Boston Heights	846	1,000	1,100	1,200	1,300	1,300
Clinton	1,335	1,700	2,100	2,400	2,500	2,600
Fairlawn	6,102	8,600	10,700	12,300	13,100	13,400
Hudson	3,933	5,500	7,100	8,700	8,100	10,000
Lakemore	2,708	3,000	3,300	3,600	3,800	3,800
Macedonia	6,375	8,500	10,300	11,700	12,500	12,700
Mogadore (Part)	3,207	3,100	3,200	3,400	3,500	3,500
Northfield	3,870	4,100	4,500	5,000	5,600	6,200

POPULATION DATA (Cont'd.)

Summit County	1970	1980	1990	2000	2010	2020
Villages (Cont'd.)						
Peninsula	692	800	900	1,000	1,000	1,000
Richfield	3,228	6,000	9,000	9,500	10,200	11,000
Reminderville	215	4,000	6,000	8,000	10,000	10,000
Silver Lake	3,637	4,000	4,200	4,400	4,400	4,400
Twinsburg	6,432	8,600	10,400	11,900	12,700	12,900
Townships						
Bath	7,552	9,400	11,100	12,500	13,200	13,400
Boston	1,504	1,900	2,200	2,500	2,600	2,700
Copley	8,633	10,800	12,700	14,300	15,100	15,300
Coventry	13,429	16,800	19,800	22,200	23,500	23,700
Franklin	15,114	18,900	22,300	25,000	26,500	26,700
Green	13,473	16,800	19,900	22,300	23,600	23,800
Hudson	4,462	6,500	7,300	7,800	8,600	9,100
Northampton	5,662	7,100	8,400	9,400	10,000	10,100
Northfield Center	3,950	7,000	11,000	13,000	15,000	17,000
Richfield	1,715	2,000	3,000	4,500	5,200	7,000
Sagamore Hills	6,710	10,000	13,000	18,000	21,000	22,000
Springfield	16,921	21,200	25,000	28,000	29,600	29,900
Twinsburg	1,415	1,800	2,100	2,300	2,500	2,500

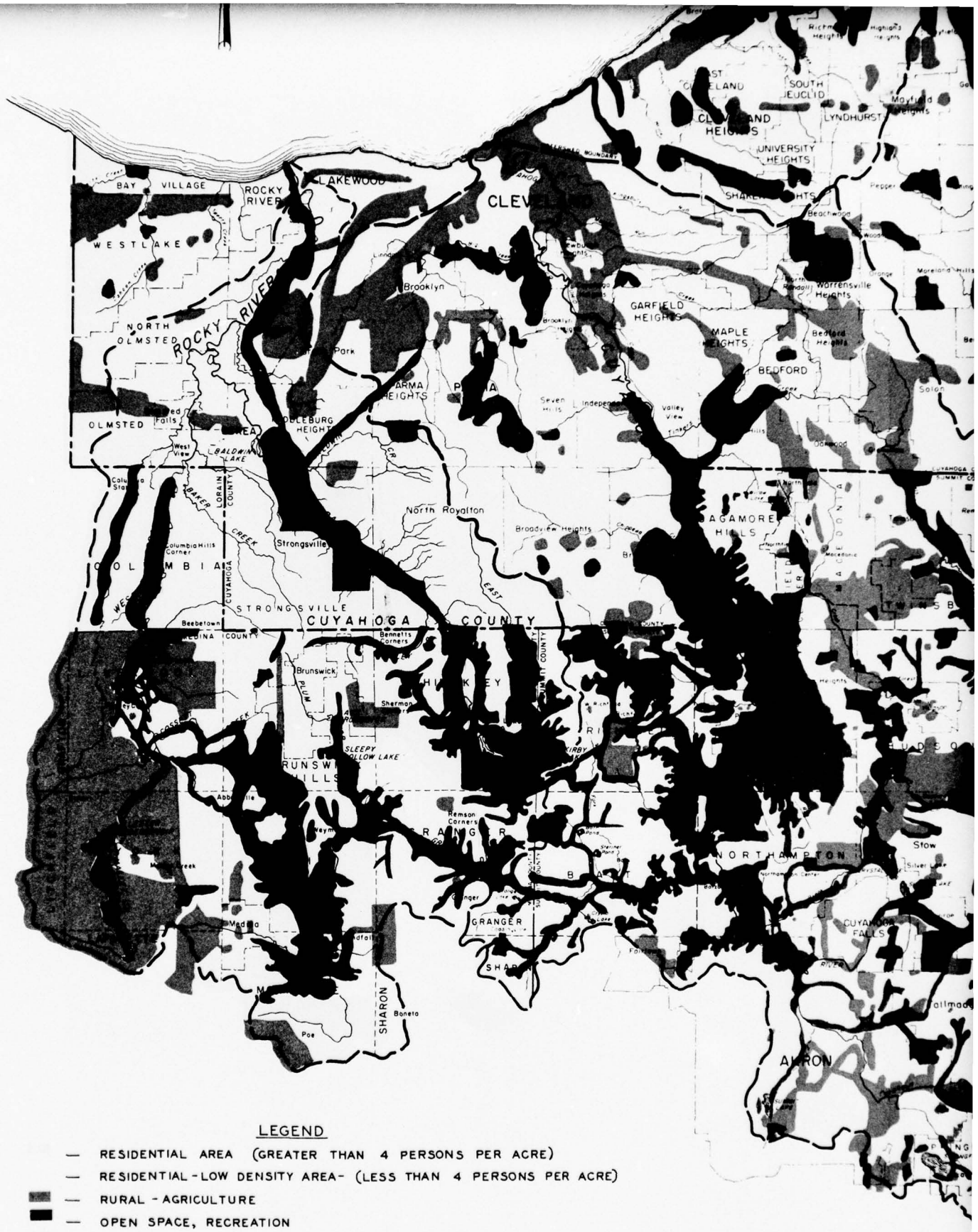
2. Land Use - A composite land use map has been prepared using the land use projections of the local planning agencies. Certain modifications have been made to reflect current land use policies and proposed changes. The history of land use planning in Northeast Ohio has not been one of widespread success. Too often land use and zoning policies have been changed to accomodate development with little or no thought being given to long term effects or aesthetics. Until such time as land use planning is made more effective, it will be subject to incidental changes and spot zoning, and can only be considered a desirable concept of long term development. Because of this uncertainty, the composite land use plan shown herein categorizes only industrial-commercial, residential, agricultural, open space and low density residential.

Figure A-2-1 shows the land use concept for the study area.

The plan shown is the land use concept for both 1990 and 2020, with the major difference being in the population densities. The residential areas would approach the upper limit of the density range as the end of the time frame approaches. Using the land use map and associated densities of population, the land use plan will accommodate the projected 2020 population.


LAKE ERIE
N
BAY VILLAGE
ROCKY RIVER
LAKEWOOD
CLEVELAND
WESTLAKE
NORTH OLMSTED
ROCKY RIVER
Brooklyn
Park
ARMA HEIGHTS
OLMSTED FALLS
OLMSTED TWP.
BALDWIN LAKE
LORAIN COUNTY
BAKER CREEK
CUYAHOGA
Columbia Hills Corner
Strongsville
COLUMBIA
STRONGSVILLE
CUYAHOGA COUNTY
Beebetown
Bennetts Corners
Brunswick
PLUM
Sherman
SLEEPY HOLLOW LAKE
Remson Corners
GRANGER
North Royalton
Broadview Heights
SEVEN HILLS
Seven Hills
Independence
Valley View
GARFIELD HEIGHTS
MAPLE HEIGHTS
BEDFORD
Bedford Heights
Warrensville Heights
Beachwood
SHAKER HEIGHTS
UNIVERSITY HEIGHTS
CLEVELAND HEIGHTS
LYNDHURST
SOUTH EUCLID
Mayfield Heights
EUCLID
WICKLIFFE
Willowick
Highland Heights
Richmond Heights
Orange
Moreland Hills
Solon
Oakwood
Stow
NORTHAMPTON
CUYAHOGA FALLS
Bonata


Mentor
Willowick
KIRTLAND
HAMBDEN
CHAGRIN
RIVER
Mayfield Heights
Pepper
Chagrin Falls
South Russell
AUBURN
INBRIDGE
Aurora
Reminderville
STREETSBORO
Stow
KENT



3

HAVENS AND EMERSON, LTD.


LYNDHURST
Mayfield Heights
Pepper
Beachwood
Warrensville Heights
Moreland Hills
Orange
Chagrin Falls
South Russell
Solon
Macedonia
Reminderville
AURORA POND
Mantua Center
Stow
Silver Lake
Brady Lake
Ravenna
Tallmadge
MUDDY LAKE
SANDY LAKE
New Milford
MOGADORE RESERVOIR
Magnolia
CONGRESS LAKE
Hartville
New Baltimore
CUYAHOGA COUNTY
SUMMIT COUNTY
PORTAGE COUNTY
STARK CO.
RUSSELL
NEWBURY
SOLON
AURORA
MANTUA
STREETSBORO
HIRAM
TWINSBURG
FRANKLIN
KENT
BRIMFIELD
SPRINGFIELD
SUFFIELD
MARLBORO
LAKE

4

FIGURE-A-2-1
SURVEY SCOPE STUDY
WASTE WATER MANAGEMENT PROGRAM

CLEVELAND-AKRON METROPOLITAN AND THREE RIVERS WATERSHED AREAS

U. S. ARMY ENGINEER DISTRICT, BUFFALO

LAND USE

5

3. Existing Wastewater Treatment Plants - The existing publically owned and larger private plants, (larger than 20,000 gpd), have been tabulated and are shown on Table A-3-1. This tabulation is an updating of the one given in the Feasibility Report. For most plants, operating data for 1971 was available from the Ohio Department of Health. In cases where it was not, 1970 data was used. Operating data reported for most plants consist of BOD, suspended solids and flow. Several of the small plants do not collect any operating data. Some plants do not have meters to measure the flow. Many of the larger plants run additional analyses beyond the required BOD and suspended solids.

Treatment costs are included in the reports by some of the plants; however, they must be used cautiously since the methods of cost accounting for the plants are not uniform.

The design capacity and type of treatment provided has also been tabulated, along with current plans for either expansion or abandonment. When cost for these plans are available, they are also listed.

TABLE A-3-1

OPERATING DATA AND WASTEWATER CHARACTERISTICS
WASTEWATER TREATMENT PLANTS IN THE CUYAHOGA RIVER BASIN

Municipality or Sewer District	Wastewater Characteristics: Raw Suspended Solids, mg/l	Raw 5-Day BOD mg/l	Effluent Suspended Solids, mg/l	Effluent 5-Day BOD mg/l	Year	Treatment Efficiency S.S.%	Treatment Efficiency BOD%
Cuyahoga County							
Bedford	149	246	9.9	24	1970	94%	90%
Bedford Heights	214	138	125	67	1970	42%	51%
Cleveland Easterly	131.8	126.7	39.8	25.8	1971	70%	80%
Cleveland Southerly	298.3	200.4	29.5	17.5	1971	90%	91%
Cleveland Westerly	196	472	140	170	1971	29%	64%
Euclid	207	248	71	127	1971	66%	49%
Maple Heights	188	165	9	19.3	1971	95%	88%
Solon - Central Area	296	324	154	67.2	1970	48%	79%
S.D. #1 - Parma (Woodbury Hills)	263	317	25	40	1971	90.5%	87.4%
S.D. #2 - Shar-Bon (Seven Hills)	297	301	35	32	1971	88.2%	89.4%
S.D. #3 - Richmond Heights (Scottish Highlands)	211	199	23	15	1971	89.1%	92.5%
S.D. #13 - Broadview Heights (Bramblewood Subd.)	241	294	45	53	1971	81.3%	82.0%
S.D. #13 - Brecksville	195	201	16	18	1971	91.8%	91.0%
S.D. #13 - Brecksville (South Estates)	322	322	16	30	1971	95.0%	90.7%
S.D. #13 - Walton Hills	369	230	135	63	1971	63.4%	72.6%
Cloverleaf Hilltop, Inc.		143		9	1969		94%
Pleasant Valley Shopping Center	No Data Available						
Seneca Club Apartments	No Data Available						
Geauga County							
Burton City Plant	No Data Available						
Broadwood Hills	254	345	38.8	29	1970	85%	92%
Middlefield	No Data Available						
Middlefield Trailer Park	No Data Available						
Geauga Community Hospital	No Data Available						
Jacques Mobile Home Park	No Data Available						
Plymouth Acres - Claridon S.D. #1	45	86	11	10	1970	76%	88%
Punderson State Park	No Data Available						

TABLE A-3-1

OPERATING DATA AND WASTEWATER CHARACTERISTICS
WASTEWATER TREATMENT PLANTS IN THE CUYAHOGA RIVER BASIN

haracteristics

Effluent Suspended Solids, mg/l	Effluent 5-Day BOD mg/l	Year	Treatment Efficiency S.S.%	Treatment Efficiency BOD%	Hydraulic Loading Current Flow, mgd	Cost of Treatment $/mg
9.9	24	1970	94%	90%	2.91	
125	67	1970	42%	51%	1.59	
39.8	25.8	1971	70%	80%	119.3	
29.5	17.5	1971	90%	91%	84.6	
140	170	1971	29%	64%	35.3	
71	127	1971	66%	49%	16.20	
9	19.3	1971	95%	88%	0.761	$241.20
154	67.2	1970	48%	79%	1.697	
25	40	1971	90.5%	87.4%	0.1337	
35	32	1971	88.2%	89.4%	0.054	
23	15	1971	89.1%	92.5%	0.082	
45	53	1971	81.3%	82.0%	.0188	
16	18	1971	91.8%	91.0%	1.236	
16	30	1971	95.0%	90.7%	0.0331	
135	63	1971	63.4%	72.6%	0.294	
	9	1969		94%		
38.8	29	1970	85%	92%		
11	10	1970	76%	88%		

OPERATING DATA AND WASTEWATER CHARACTERISTICS
WASTEWATER TREATMENT PLANTS IN THE CUYAHOGA RIVER BA

Municipality or Sewer District	Wastewater Characteristics: Raw Suspended Solids, mg/l	Raw 5-Day BOD mg/l	Effluent Suspended Solids, mg/l	Effluent 5-Day BOD mg/l	Year	Treatment Efficiency S.S.%	BO
Medina County							
Granger Lake Apartments	No Data Available						
Portage County							
Aurora Plant #2 - Geauga Lake	178	149	16.2	13.5	1970	91%	9
Aurora Plant #3 - Four-Seasons Subd.	187	246	29	29	1970	84%	8
Kent	218	206	25	17	1971	89%	9
Mantua	128	140	7	8.5	1971	95%	9
Ravenna	194	136	14	15.9	1971	93%	8
Aurora Acres S.D.	188	282	16	13.2	1971	91%	9
Brimfield S.D. #1 (Beechcrest)	117	141	8	2.5	1971	93%	9
Brimfield S.D. #3 (Holiday Inn)	114	128	10	3.4	1971	91%	9
Field Local School District	No Data Available						
Franklin S.D. #1	71	127	11	10.7	1971	84%	9
Franklin S.D. #3	102	246	13	6	1969	87%	97
Gille Estates S.D.	203	256	8	3.9	1971	96%	9
Kent Rhodes Apartments	No Data Available						
Randolph Trailer Park	54	222	5.4	3.2	1971	90%	9
Ravenna S.D. #1 - Lakeview Gardens	98	166	14	9.5	1971	86%	9
Ravenna S.D. #4 - Longfield	61	153	6	1.3	1971	90%	9
Rootstown S.D. #1 - Baronwood	102	207	9	10.1	1971	91%	9
Shalersville S.D. #1 - Red Fox	227	397	6	2.6	1971	97%	9
Shalersville S.D. #2 - Boling Brook	204	277	11	8.1	1971	95%	9
Streetsboro S.D. #2 - Arrowhead	157	244	10	8.4	1969	93.6%	96
Streetsboro S.D. #3 - Rolling Hills	170	235	9	5.5	1971	95%	9
Valley Hills Trailer Park	120	232	12	7.1	1971	90%	9
Sandy Lakes	116	169	11	4.2	1971	91%	9
Twin Lakes	No Data Available						

OPERATING DATA AND WASTEWATER CHARACTERISTICS
WASTEWATER TREATMENT PLANTS IN THE CUYAHOGA RIVER BASIN

teristics Effluent spended ids, mg/l	5-Day BOD mg/l	Year	Treatment Efficiency S.S.%	BOD%	Hydraulic Loading Current Flow, mgd	Cost of Treatment $/mg
16.2	13.5	1970	91%	91%	0.118	
29	29	1970	84%	88%	0.120	
25	17	1971	89%	92%	2.830	
7	8.5	1971	95%	94%	0.214	$108.00
14	15.9	1971	93%	88%	1.204	$118.20
16	13.2	1971	91%	95%	.066	$477.36
8	2.5	1971	93%	98%	0.1886	$228.65
10	3.4	1971	91%	97%	0.034	$369.61
11	10.7	1971	84%	92%	.087	$305.64
13	6	1969	87%	97.5%		
8	3.9	1971	96%	98%	0.2404	$383.58
5.4	3.2	1971	90%	99%		
14	9.5	1971	86%	94%	0.0379	$440.46
6	1.3	1971	90%	99%	.004	
9	10.1	1971	91%	95%	0.0526	$472.44
6	2.6	1971	97%	99%	0.062	$891.93
11	8.1	1971	95%	97%	0.1043	$289.27
10	8.4	1969	93.6%	96.7%		
9	5.5	1971	95%	98%	0.0677	$377.14
12	7.1	1971	90%	97%	.567	$411.00
11	4.2	1971	91%	98%	.033	$609.59

OPERATING DATA AND WASTEWATER CHARACTERISTICS
WASTEWATER TREATMENT PLANTS IN THE CUYAHOGA RIVER BASIN

Municipality or Sewer District	Wastewater Characteristics Raw Suspended Solids, mg/l	Raw 5-Day BOD mg/l	Effluent Suspended Solids, mg/l	Effluent 5-Day BOD mg/l	Year	Treatment Efficiency S.S.%	Treatment Efficiency BOD%
Summit County							
Akron	244	152	41	25	1971	83%	84
Hudson (Village)	180	252	24	41	1970	87%	84%
Northfield	178	231	41	39	1971	77%	83%
Tallmadge	158	367	4	8	1969	97.5%	97.8%
Twinsburg	227	217	32	27	1970	86%	88%
S.D. #1 - Roseland Estates	112	146	14	25.4	1971	87%	83%
S.D. #5 - Hudson	133	149	11	6.9	1971	92%	95%
S.D. #6 - General Motors	154	164	73	54.5	1971	52%	67%
S.D. #7 - Nagy Park Estates	108	207	9	5	1971	92%	98%
S.D. #9 - Macedonia Estates	185	185	24	26.3	1971	87%	86%
S.D. #14 - Renee Estate	173	182	9	3.7	1971	95%	98%
S.D. #15 - Northfield-Macedonia	166	150	12	14.7	1971	92.7%	90.2%
S.D. #17 - Conn. Colonys Allot.	208	222	17	13.2	1971	91%	94%
Greenwood of Sagamore Hills	183	165	23	21.6	1971	87.4%	86.8%
Hawthornden State Hospital	No Data Available						
Musical Arts Assoc. (Blossom Music Center)	No Data Available						
Ohio 21-Corp.	No Data Available						
Revere Local School District	No Data Available						
Stow-Kent Assoc.	No Data Available						
Click Store #21			15.5	75.4	1971		
K-Mart #22	190	420	41	13.1	1971	78.5%	96.9%

OPERATING DATA AND WASTEWATER CHARACTERISTICS
WASTEWATER TREATMENT PLANTS IN THE CUYAHOGA RIVER BASIN

er Characteristics

D	Effluent Suspended Solids, mg/l	Effluent 5-Day BOD mg/l	Year	Treatment Efficiency S.S.%	Treatment Efficiency BOD%	Hydraulic Loading Current Flow, mgd	Cost of Treatment $/mg
	41	25	1971	83%	84	75.99	$ 64.66
	24	41	1970	87%	84%	.591	
	41	39	1971	77%	83%	.581	
	4	8	1969	97.5%	97.8%		
	32	27	1970	86%	88%	.765	
	14	25.4	1971	87%	83%	.091	
	11	6.9	1971	92%	95%	.1589	
	73	54.5	1971	52%	67%	.7891	
	9	5	1971	92%	98%		
	24	26.3	1971	87%	86%		
	9	3.7	1971	95%	98%		
	12	14.7	1971	92.7%	90.2%	1.199	
	17	13.2	1971	91%	94%	.0648	
	23	21.6	1971	87.4%	86.8%		
le							
le							
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le							
le							
	15.5	75.4	1971				
	41	13.1	1971	78.5%	96.9%		

OPERATING DATA AND WASTEWATER CHARACTERISTICS
WASTEWATER TREATMENT PLANTS IN THE ROCKY RIVER BASIN

Municipality or Sewer District	Wastewater Characteristics: Raw Suspended Solids, mg/l	Raw 5-Day BOD mg/l	Effluent Suspended Solids, mg/l	Effluent 5-Day BOD mg/l	Year	Treatment Efficiency S.S.%	Treatment Efficiency BOD%
Cuyahoga County							
Berea	207	200	18	18	1971	91%	91%
Brookpark	203	230	11.1	6.3	1971	95%	97%
Lakewood	124	127	20	11	1971	84%	91%
North Olmsted	190	177	9	9	1970	94%	95%
North Royalton - Area "A"	181	208	12	3	1971	93.5%	98.5%
North Royalton - Area "B"	137	207	12	5	1971	91%	97.5%
Strongsville - Area "A"	173	168	9	6	1971	95%	96%
Strongsville - Area "B"	141	173	6.4	4	1971	95%	98%
Strongsville - Area "C"	150	186	9	6	1971	94%	97%
S.D. #6 - Rocky River	161	178	81	121.0	1971	49.6%	32.0%
S.D. #8 - Middleburg Heights	175	148	17	9.9	1971	90.3%	93.3%
S.D. #14 - Brentwood Estates	157	145	13.3	7.4	1971	91.5%	94.8%
Lakewood Country Club	No Data Available						
Olmsted Falls School District	No Data Available						
Medina County							
Medina	247	267	80	60	1971	67.6%	77.5%
S.D. #7 - Colony Park	233	202	16	10.5	1971	93%	95%
S.D. #8 - Beverly Hills	154	130	16	10.6	1971	90%	92%
S.D. #9 - Hinckley Lake	No Data Available						
S.D. #11 - Village Homes	No Data Available						
S.D. #100 - Medina County	241	175	18	14	1971	93%	92%
S.D. #500 - Liverpool	268	137	27	8.3	1971	90%	94%

OPERATING DATA AND WASTEWATER CHARACTERISTICS
WASTEWATER TREATMENT PLANTS IN THE ROCKY RIVER BASIN

er Characteristics

OD	Effluent Suspended Solids, mg/l	Effluent 5-Day BOD mg/l	Year	Treatment Efficiency S.S.%	Treatment Efficiency BOD%	Hydraulic Loading Current Flow, mgd	Cost of Treatment $/mg
	18	18	1971	91%	91%	1.726	$158.41
	11.1	6.3	1971	95%	97%	0.784	
	20	11	1971	84%	91%	16.70	$ 55.89
	9	9	1970	94%	93%	3.68	
	12	3	1971	93.5%	98.5%	0.228	
	12	5	1971	91%	97.5%	0.301	
	9	6	1971	95%	96%	0.797	
	6.4	4	1971	95%	98%	0.177	
	9	6	1971	94%	97%	0.092	
	81	121.0	1971	49.6%	32.0%	7.097	
	17	9.9	1971	90.3%	93.3%	1.167	
	13.3	7.4	1971	91.5%	94.8%	0.0263	
	80	60	1971	67.6%	77.5%	1.47	
	16	10.5	1971	93%	95%	.096	
	16	10.6	1971	90%	92%		
	18	14	1971	93%	92%	.871	
	27	8.3	1971	90%	94%	.488	

OPERATING DATA AND WASTEWATER CHARACTERISTICS
WASTEWATER TREATMENT PLANTS IN THE CHAGRIN RIVER BASIN

Municipality or Sewer District	Wastewater Characteristics: Raw Suspended Solids, mg/l	Raw 5-Day BOD mg/l	Effluent Suspended Solids, mg/l	Effluent 5-Day BOD mg/l	Year	Treatment Efficiency S.S.%	Treatment Efficiency BOD%
Cuyahoga County							
Chagrin Falls	134	178	18	13	1970	87%	93%
Pepper Pike - Creek Side	150	116	11	6	1971	92.7%	94.8%
Pepper Pike - Pepper Hills	153	132	17	9	1971	88.9%	93.2%
Hickory Hills - Mayfield Heights	368	263	46	20	1971	87.5%	92.4%
Solon - N. & N.E. Area	135	130	6	8	1971	95.5%	93.8%
Apple Hill Town House Corp. (Moreland Hills)	No Data Available						
Country Club, Inc.	No Data Available						
Woodbran Corp.	215	200	19	9	1969	89%	96%
Geauga County							
S.D. #2 - Chester Twp. (Willow Hills Estate)	265	266	13.7	13.7	1970	91%	95%
S.D. #1 - Bainbridge Twp. (Pilgrim Village Subd.)	219	278	58	50	1970	74%	82%
Chagrin River S.D.							
Russell Park	71	138	10.9	4.4	1970	85%	97%
Wenhaven	106	131	10.3	10.6	1970	90%	92%
Opalacka	153	190	40	27	1970	74%	86%
McFarland Creek S.D.							
South Russell	176	280	22	17	1970	88%	94%
Ravenwood	276	285	24	21	1970	91%	93%
Tanglewood	91	171	22	20.6	1970	70%	95%
Knowles Indus. Park	No Data Available						
Newbury Local School	No Data Available						
Silver Creek School District	No Data Available						
West Geauga Local School	No Data Available						
Belle Vernon Acres	80	95	6.6	3.4	1970	92%	96%
Wilder Mobile Home Park	No Data Available						
Scarsdale Estates	207	210	10.2	6.2	1970	95%	97%
Notre Dame Educ. Center	No Data Available						
Willoughby-Eastlake	167	130	73	92	1971	56%	29%
Willoughby Hills (Dodd's Hill Subd.)	No Data Available						

OPERATING DATA AND WASTEWATER CHARACTERISTICS
WASTEWATER TREATMENT PLANTS IN THE CHAGRIN RIVER BASIN

Effluent Characteristics			Treatment Efficiency			
Suspended Solids, mg/l	5-Day BOD mg/l	Year	S.S.%	BOD%	Hydraulic Loading Current Flow, mgd	Cost of Treatment $/mg
18	13	1970	87%	93%	0.610	
11	6	1971	92.7%	94.8%	0.0645	
17	9	1971	88.9%	93.2%	0.035	
46	20	1971	87.5%	92.4%	0.0268	
6	8	1971	95.5%	93.8%	0.228	$527.60
19	9	1969	89%	96%		
13.7	13.7	1970	91%	95%		
58	50	1970	74%	82%		
10.9	4.4	1970	85%	97%		
10.3	10.6	1970	90%	92%		
40	27	1970	74%	86%		$528.46
22	17	1970	88%	94%		
24	21	1970	91%	93%		
22	20.6	1970	70%	95%		
6.6	3.4	1970	92%	96%		
10.2	6.2	1970	95%	97%		
73	92	1971	56%	29%	4.28	$ 69.88

OPERATING DATA AND WASTEWATER CHARACTERISTICS
WASTEWATER TREATMENT PLANTS IN THE CHAGRIN RIVER BAS

Municipality or Sewer District	Wastewater Characteristics					Treatment Efficiency	
	Raw		Effluent				
	Suspended Solids, mg/l	5-Day BOD mg/l	Suspended Solids, mg/l	5-Day BOD mg/l	Year	S.S.%	BO
Portage County							
Aurora (Plant #1)	110	155	19	14	1971	83%	
Robbins Trailer Park	No Data Available						

OPERATING DATA AND WASTEWATER CHARACTERISTICS
WASTEWATER TREATMENT PLANTS IN THE CHAGRIN RIVER BASIN

Characteristics

Effluent			Treatment Efficiency			
Suspended Solids, mg/l	5-Day BOD mg/l	Year	S.S.%	BOD%	Hydraulic Loading Current Flow, mgd	Cost of Treatment $/mg
19	14	1971	83%	91%	0.370	$138.00

4. Plant Value - Actual worth of the publicly owned plants and larger private plants was computed by the "reconstruction cost new less depreciation" method. Generally, reconstruction cost new was taken from generalized cost curves updated to 1972 price levels, except when the actual construction cost was recent and available. In some cases, such as the Cleveland plants, this cost had recently been computed and was simply up-dated for this study. Depreciation was taken at 2% per year for the larger facilities and 4-6% per year for the smaller plants. In some cases, the purchase price of small package plants was used, and actual worth was estimated, based on present condition. Actual worth as well as the reconstruction cost was reviewed with the County Sanitary Engineers.

Table A-4-1 tabulates the existing plant values and expansion plans.

In many cases, accurate figures for outstanding indebtedness are not available, since the auditors' debt figures often include debt on sewers, pumping stations and other facilities as well as treatment works. Where separated figures were known, they are shown in the tabulation.

TABLE A-4-1
PLANT VALUES AND EXPANSION PLAN

CUYAHOGA RIVER BASIN

Municipality or Sewer District	Type of Plant	Design Flow (mgd)	Expansion Plans
Cuyahoga County			
Bedford	S	2.2	Plans for expansion to 3.2 mgd are under consideration - estimated cost - $1,200,000
Bedford Heights	T	3.6	
Cleveland Easterly	S	172.0	To be expanded with tertiary to 380 mgd - 1970-1975 - estimated cost - $37,000,000
Cleveland Southerly	S	96.0	To be expanded with tertiary - 1975-1977 estimated cost - $70,000,000
Cleveland Westerly	P	36.0	To be expanded with tertiary to 50 mgd - 1970-1975 - estimated cost - $32,000,000
Euclid	I	18.0	Secondary and tertiary to be added 1970-1975 - estimated cost - $11,500,000
Maple Heights	S	1.0	To be abandoned and tied into C.V.I.
Solon - Central Area	S	2.4	
S.D. #1 - Parma (Woodbury Hills)	S	.12	To be abandoned and tied into 1-M-1 Interceptor - 1975-1980
S.D. #2 - Shar-Bon (Seven Hills)	S	.05	To be abandoned and tied into Crossview Interceptor - 1975-1980
S.D. #3 - Richmond Heights (Scottish Highlands)	S	.16	None
S.D. #13 - Broadview Heights (Bramblewood Subd.)	S	.02	None
S.D. #13 - Brecksville	S	1.0	To be abandoned and tied into C.V.I. - 1975-1980
S.D. #13 - Brecksville (Southern Estates)	S	.03	To be abandoned and tied into C.V.I. - 1975-1980
S.D. #13 - Walton Hills	S	.25	Holding tanks to be added
Cloverleaf Hilltop, Inc.	S	.03	To be abandoned and tied into C.V.I.
Pleasant Valley Shopping Center	S	.035	To be abandoned and connected to Keystone Sprague Interceptor
Geauga County			
Burton City Plant	S	0.06	Expansion plants under design
Broadwood Hills	S	0.0275	
Middlefield	P	0.13	Adding secondary lagoons
Middlefield Trailer Park	S	.028	
Geauge Community Hospital	S	0.03	
Jacques Mobile Home Park	S	0.025	

TABLE A-4-1
VALUES AND EXPANSION PLAN

CUYAHOGA RIVER BASIN

Expansion Plans	Reconstr. Cost New	Actual Worth	Outstanding Debt
Plans for expansion to 3.2 mgd are under consideration - estimated cost - $1,200,000	$ 2,210,000	$ 1,270,000	$
	3,600,000	3,600,000	
To be expanded with tertiary to 380 mgd - 1970-1975 - estimated cost - $37,000,000	99,853,551	53,516,312	
To be expanded with tertiary - 1975-1977 estimated cost - $70,000,000	110,130,155	67,931,838	
To be expanded with tertiary to 50 mgd - 1970-1975 - estimated cost - $32,000,000	19,247,142	8,143,050	
Secondary and tertiary to be added 1970-1975 - estimated cost - $11,500,000	12,000,000	9,000,000	
To be abandoned and tied into C.V.I.	1,180,000	800,000	
	2,400,000	1,735,000	
To be abandoned and tied into 1-M-1 Interceptor - 1975-1980	128,000	60,800	
To be abandoned and tied into Crossview Interceptor - 1975-1980	87,000	30,000	
None	147,000	60,000	
None	20,000	8,000	
To be abandoned and tied into C.V.I. - 1975-1980	1,180,000	600,000	
To be abandoned and tied into C.V.I. - 1975-1980	69,000	20,000	
Holding tanks to be added	180,000	121,000	
To be abandoned and tied into C.V.I.	40,000	10,000	
To be abandoned and connected to Keystone-Sprague Interceptor	45,000	12,000	
Expansion plants under design	94,000	24,000	
	66,000	22,000	
Adding secondary lagoons	100,000	25,000	
	60,000	2,000	
	69,000	23,000	
	64,000	21,000	

CUYAHOGA RIVER BASIN (Cont'd.)

Municipality or Sewer District	Type of Plant	Design Flow (mgd)	Expansion Plans
Geauga County (Cont'd.)			
Plymouth Acres, Claridon S.D. #1	S	0.012	
Punderson State Park	S	0.022	Expansion for park area - contracts awarded 1972
Medina County			
Granger Lake Apartments	S	0.04	
Portage County			
Aurora Plant #2 - Geauga Lake	S	0.2	To be abandoned and tied into Aurora Westerly - 1972-1975
Aurora Plant #3 - Four-Seasons Subd.	S	.12	To be abandoned and tied into Aurora Westerly - 1972-1975
Kent	S	4.0	
Mantua	S	0.3	
Ravenna	S	1.25	Plant enlargement in cooperation with Portage County
Aurora Acres S.D.	S	0.048	To be abandoned and tied into Aurora Westerly - 1972-1975
Brimfield S.D. #1 (Beechcrest)	S	0.2	To be abandoned and tied into Fish Creek 1975-1980
Brimfield S.D. #3 (Holiday Inn)	S	0.045	To be abandoned and tied into Fish Creek 1975-1980
Field Local School District	S	0.034	
Franklin S.D. #1 (Franklin Hills)	S	0.09	Expansion to 1.0 mgd under design - estimated cost - $500,000
Franklin S.D. #3 (Dale Terrace)	S	0.044	To be abandoned and tied into Franklin Hills - 1973
Gille Estates S.D.	S	0.44	
Kent Rhodes Apartments	S	0.03	
Randolph Trailer Park	T	0.04	
Ravenna S.D. #1 Lakeview Gardens	S	0.02	To be abandoned and tied into Ravenna Plant - 1973-1975
Ravenna S.D. #4 Longfield	S	0.03	To be abandoned and tied into Ravenna Plant - 1973-1975
Rootstown S.D. #1 Baronwood	S	0.08	To be abandoned and tied into Ravenna Plant - 1975-1980
Shalersville S.D. #1 (Red Fox)	S	0.16	

CUYAHOGA RIVER BASIN (Cont'd.)

Expansion Plans	Reconstr. Cost New	Actual Worth	Outstanding Debt
	$ 22,000	$ 10,000	$
Expansion for park area - contracts awarded 1972	60,000	20,000	
	78,000	26,000	
To be abandoned and tied into Aurora Westerly - 1972-1975	160,000	152,000	
To be abandoned and tied into Aurora Westerly - 1972-1975	130,000	117,000	
	3,600,000	3,330,000	
	123,000	107,600	
Plant enlargement in cooperation with Portage County	1,300,000	650,000	
To be abandoned and tied into Aurora Westerly - 1972-1975	78,000	26,000	
To be abandoned and tied into Fish Creek - 1975-1980	200,000	100,000	
To be abandoned and tied into Fish Creek - 1975-1980	83,000	56,000	12,000
	73,000	24,000	
Expansion to 1.0 mgd under design - estimated cost - $500,000	100,000	60,000	24,000
To be abandoned and tied into Franklin Hills - 1973	82,000	8,000	
	450,000	300,000	90,000
	69,000	35,000	
	78,000	20,000	
To be abandoned and tied into Ravenna Plant - 1973-1975	57,000	18,000	
To be abandoned and tied into Ravenna Plant - 1973-1975	70,000	50,000	
To be abandoned and tied into Ravenna Plant - 1975-1980	108,000	35,000	
	147,000	100,000	

CUYAHOGA RIVER BASIN (Cont'd.)

Municipality or Sewer District	Type of Plant	Design Flow (mgd)	Expansion Plans
Portage County (Cont'd.)			
Shalersville S.D. #2 Bolingbrook	S	0.13	
Streetsboro S.D. #2 Arrowhead	S	0.064	
Streetsboro S.D. #3 Rolling Hills	S	0.12	
Sandy Lakes	S	.056	To be abandoned and tied into Ravenna Plant - 1973-1977
Twin Lakes	T (Microst.)	.600	
Summit County			
Akron	S	87.5	
Hudson	S	0.55	Aerated Lagoons under design, eventually to be tied into Macedonia
Northfield	S	0.4	
Tallmadge	S	0.15	
Twinsburg	S	0.6	Expansion with tertiary addition to 2.2 mgd - 1970-1975
S.D. #1 Roseland Estates	S	0.1	Connect to Twinsburg - 1975-1980
S.D. #5 Hudson	S	0.2	Discussion of expansion to 1.2 mgd 1974-1975 - estimated cost - $1,000,000
S.D. #6 General Motors	T	1.5	
S.D. #7 Nagy Park Estates	S	0.03	To be tied into Cuyahoga Valley Interceptor
S.D. #9 Macedonia	S	0.03	
S.D. #14 Renee Estates	S	0.1	To be abandoned and tied into Fish Creek - 1975
S.D. #15 Northfield-Macedonia	S	1.0	Expansion with tertiary to 6.0 mgd
S.D. #17 Conn. Colonys Allot.	S	0.04	
Greenwood of Sagamore Hills	S	0.120	
Hawthornden State Hospital	S	0.3	To be abandoned and connected to Cuyahoga Valley Interceptor 1975-1980
Musical Arts Assoc. (Blossom Music Center)	S	0.09	
Ohio 21 - Corp.	S	0.06	
Stow-Kent Assoc.	S	0.03	
K-Mart	S	0.02	

GA RIVER BASIN (Cont'd.)

Expansion Plans	Reconstr. Cost New	Actual Worth	Outstanding Debt
	$ 133,000	$ 95,000	$
	94,000	75,000	
	180,000	100,000	50,000
To be abandoned and tied into Ravenna Plant - 1973-1977	120,000	100,000	70,000
	400,000	400,000	280,000
	39,000,000	31,200,000	
Aerated Lagoons under design, eventually to be tied into Macedonia	720,000	500,000	
	560,000	420,000	
	142,000	71,000	
Expansion with tertiary addition to 2.2 mgd - 1970-1975	770,000	578,000	
Connect to Twinsburg - 1975-1980	120,000	40,000	
Discussion of expansion to 1.2 mgd 1974-1975 - estimated cost - $1,000,000	160,000	120,000	
	1,300,000	1,300,000	
To be tied into Cuyahoga Valley Interceptor	30,000	10,000	
	30,000	10,000	
To be abandoned and tied into Fish Creek - 1975	120,000	40,000	
Expansion with tertiary to 6.0 mgd	1,180,000	800,000	
	45,000	20,000	
	94,000	94,000	
To be abandoned and connected to Cuyahoga Valley Interceptor 1975-1980	190,000	40,000	
	112,000	112,000	
	94,000	40,000	
	30,000	20,000	
	20,000	14,000	

ROCKY RIVER BASIN

Municipality or Sewer District	Type of Plant	Design Flow (mgd)	Expansion Plans
Cuyahoga County			
Berea	S	3.0	
Brookpark	S	1.0	
Lakewood	S	13.0	
North Olmsted	T	9.0	
North Royalton - Area "A"	S	1.5	Sludge removed being studied
North Royalton - Area "B"	S	1.0	Sludge removed being studied
Strongsville - Area "A"	S	1.0	Either abandoned or temporarily enlarged
Strongsville - Area "B"	S	0.25	To be expanded to 1.2 mgd plant with tertiary - 1970-1975 - estimated cost - $1,000,000
Strongsville - Area "C"	S	0.37	To be expanded with tertiary - 1970-1975
S.D. #6 Rocky River	I	16.0	Secondary to be added 1970-1975, Contract awarded but in litigation estimated cost - $3,500,000
S.D. #8 Middleburg Heights	T	2.0	Expandable to 4.0 mgd with minor modifications
S.D. #14 Brentwood Estates	S	0.16	To be abandoned and tied into Westlake Interceptor - 1975-1980
Lakewood Country Club	S	0.025	To be abandoned and tied into Westlake Interceptor - 1975-1980
Olmsted Falls School District	S	0.03	
Medina County			
Medina	S	1.35	To be abandoned and tied into Medina-Liverpool Plant - 1970-1975
S.D. #7 Colony Park	S	.13	To be abandoned and tied into Medina-Hinckley Plant - 1970-1975
S.D. #8 Beverly Hills	S	.13	Temporary expansion to 0.26 mgd until abandoned in 1975 - estimated cost - $60,
S.D. #9 Hinckley Lake	S	.010	To be abandoned and tied into new Hinckley Regional Plant in 1980-1985
S.D. #11 Village Homes	S	0.012	To be abandoned and tied into Liverpool Plant - 1985-1990
S.D. #100 Medina County	S	2.0	To be abandoned and tied into Liverpool Plant - 1975
S.D. #500 Liverpool	S	1.5	To be enlarged and become regional plant

OCKY RIVER BASIN

Expansion Plans	Reconstr. Cost New	Actual Worth	Outstanding Debt	
	$ 2,850,000	$ 2,000,000	$	
	800,000	600,000		
	9,300,000	8,603,000		
	8,000,000	7,000,000		
Sludge removed being studied	1,620,000	1,214,000		
Sludge removed being studied	1,180,000	885,000		
Either abandoned or temporarily enlarged	900,000	700,000		
To be expanded to 1.2 mgd plant with tertiary - 1970-1975 - estimated cost - $1,000,000	180,000	135,000		
To be expanded with tertiary - 1970-1975	320,000	250,000		
Secondary to be added 1970-1975, Contract awarded but in litigation estimated cost - $3,500,000	8,400,000			
Expandable to 4.0 mgd with minor modifications	3,000,000			
To be abandoned and tied into Westlake Interceptor - 1975-1980	148,000	49,000		
To be abandoned and tied into Westlake Interceptor - 1975-1980	64,000	21,000		
	69,000	23,000		
To be abandoned and tied into Medina-Liverpool Plant - 1970-1975	1,500,000	620,000		
To be abandoned and tied into Medina-Hinckley Plant - 1970-1975	130,000	40,000		
Temporary expansion to 0.26 mgd until abandoned in 1975 - estimated cost - $60,000	130,000	40,000		
To be abandoned and tied into new Hinckley Regional Plant in 1980-1985	20,000	3,000	0	
To be abandoned and tied into Liverpool Plant - 1985-1990	24,000	5,000	0	
To be abandoned and tied into Liverpool Plant - 1975	2,000,000	1,000,000	800,000	(w/interest)
To be enlarged and become regional plant	1,200,000	1,200,000	4,000,000	(w/interest & include sewers)

CHAGRIN RIVER BASIN

Municipality or Sewer District	Type of Plant	Design Flow (mgd)	Expansion Plans
Cuyahoga County			
Chagrin Falls	S	0.4	Expansion with tertiary under design
Pepper Pike - Creek Side	S	.12	
Pepper Pike - Pepper Hills	S	0.05	
Hickory Hills - Mayfield Heights	S	0.03	
Solon - N. & N.E. Area	S	0.78	
Apple Hill Town House Corp. (Moreland Hills)	S	0.025	
Country Club Inc.	S	0.05	
Woodbran Corp.	S	0.22	
Geauga County			
S.D. #2 Chester Twp. (Willow Hills Estates)	S	0.012	
S.D. #1 Bainbridge Twp. (Pilgrim Village Subd.)	S	0.025	
Chagrin River S.D.			
Russell Park	S	0.02	
Wenhaven	S	0.008	
Opalacka	T	0.08	
McFarland Creek S.D.			
South Russell	S	0.09	To be abandoned and tied into
Ravenwood	S	0.0125	McFarland Creek S.D. proposed
Tanglewood	T (lagoon)	0.120	regional plant.
Knowles Indus. Park	S	0.018	
Newbury Local School	S	0.03	
Silver Creek School District	S	0.01	
West Geauga Local School	S	0.06	
Belle Vernon Acres	S	0.04	
Wilder Mobile Home Park	S	0.03	
Scarsdale Estate	T	.027	
Notre Dame Educ. Center	S	0.04	
Willoughby-Eastlake	I	3.86	
Willoughby Hills (Dodd's Hill Subd.)	T	0.024	
Portage County			
Aurora (Plant #1)			
Robins Trailer Park	P	0.04	

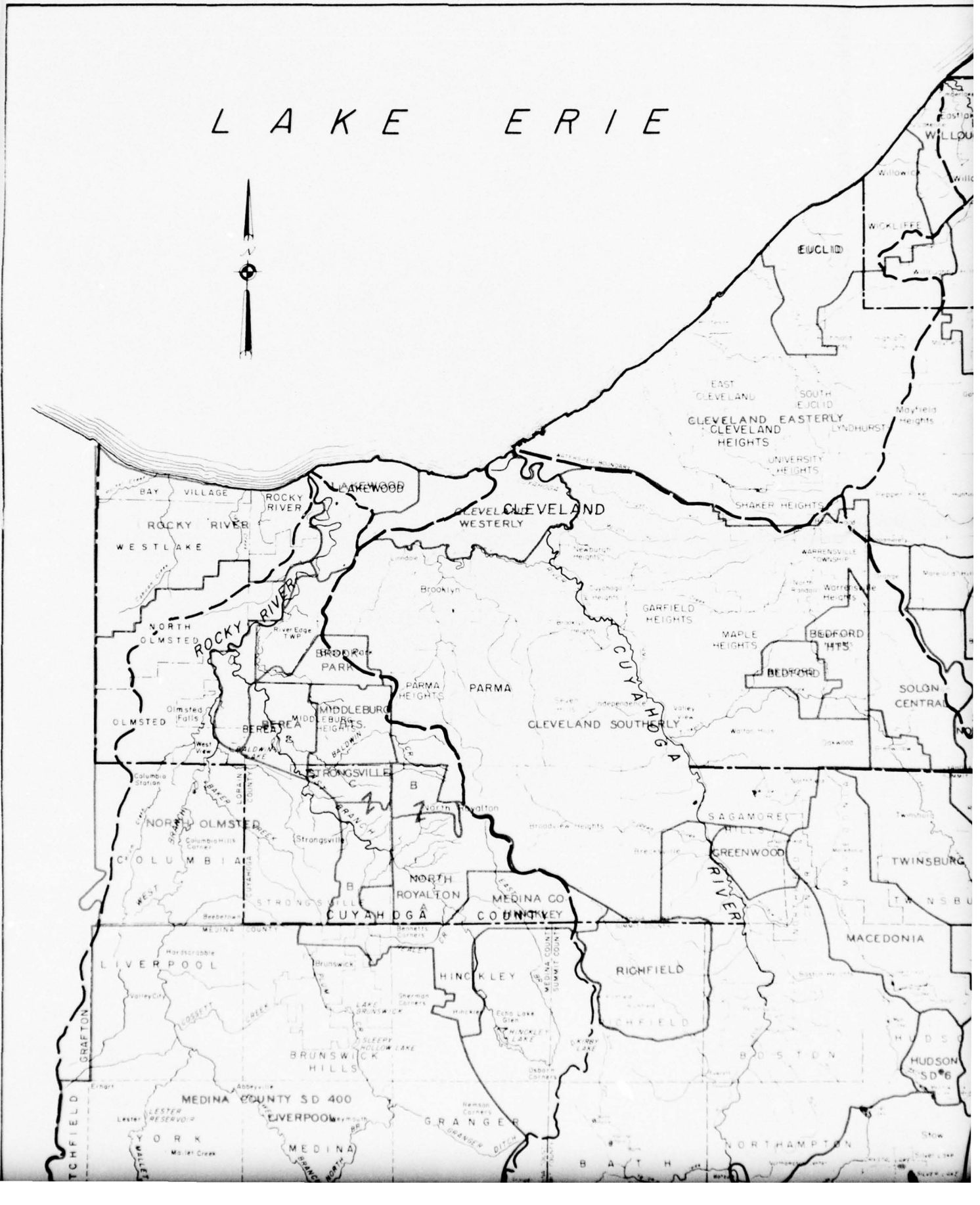
CHAGRIN RIVER BASIN

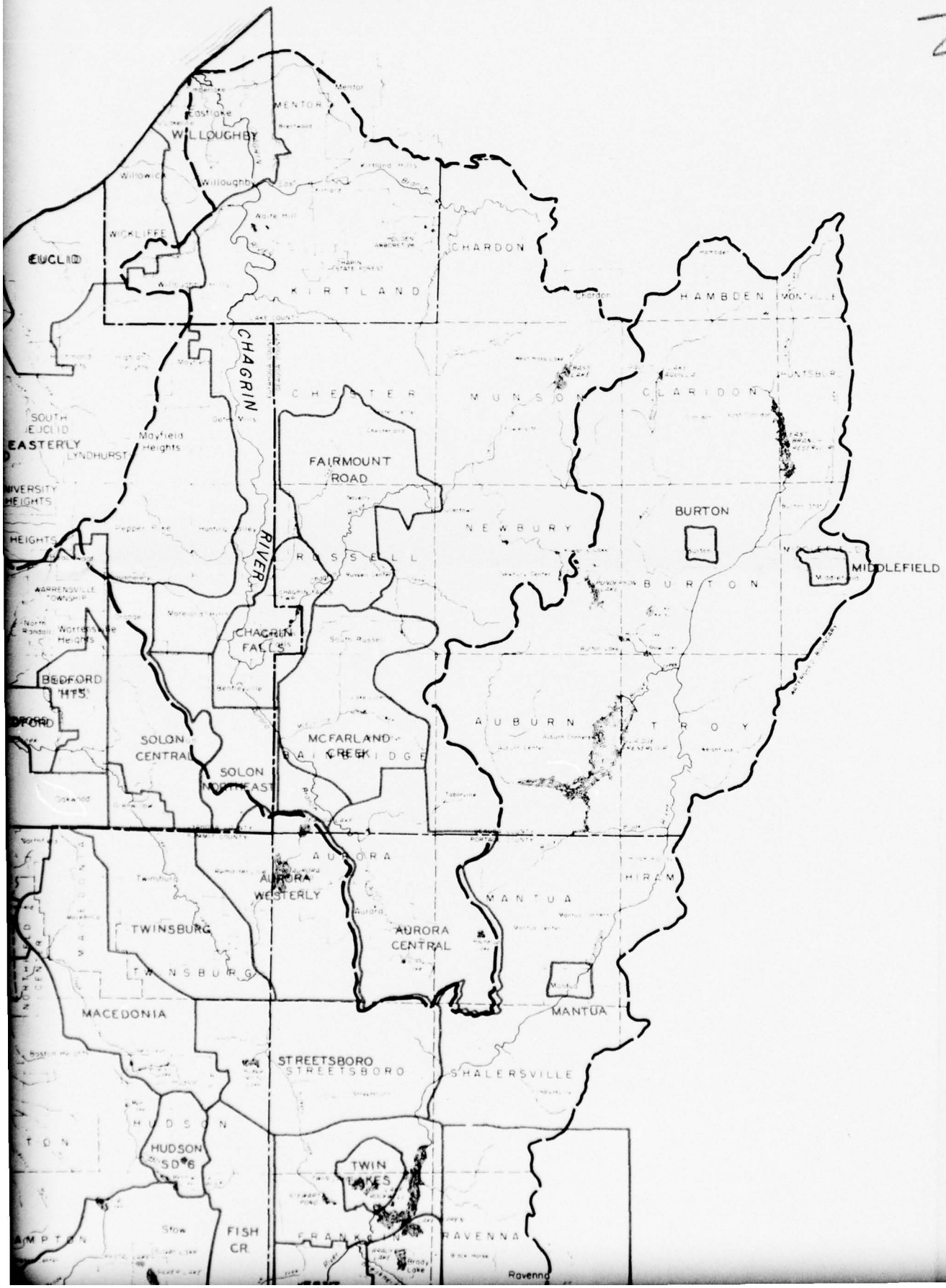
Expansion Plans	Reconstr. Cost New	Actual Worth	Outstanding Debt
Expansion with tertiary under design	$ 220,000	$ 165,000	$
	87,000	29,000	
	87,000	29,000	
	69,000	23,000	
	960,000		
	64,000	21,000	
	87,000	29,000	
	170,000		
	25,000	12,000	
	50,000	20,000	
	60,000	20,000	
	15,000	8,000	
	108,000	85,000	45,000
o be abandoned and tied into cFarland Creek S.D. proposed regional plant.	112,000	70,000	
	28,500	10,000	
	160,000	90,000	
	36,000	1,000	
	69,000		
	42,000		
	94,000		
	78,000		
	69,000		
	50,000	25,000	
	78,000		
	375,000	290,000	

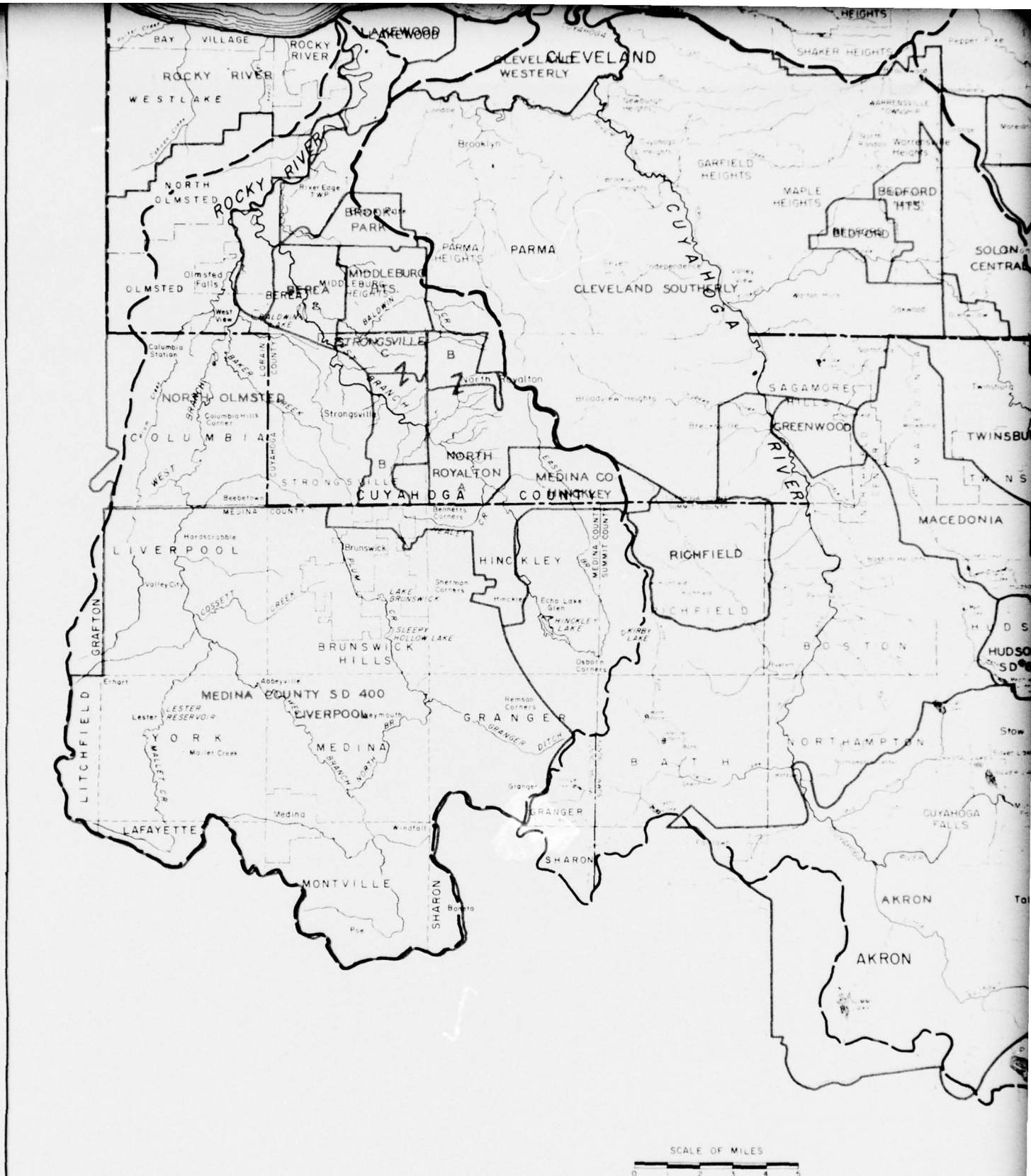
5. Subdistricts - The study area was divided into major sewerage districts that are expected to exist in 1980 or at the conclusion of improvement plans now underway. The population was calculated for each subdistrict and the population served by sewers was estimated. These subdistricts are shown on Figure A-5-1, and the populations served are tabulated on Table A-5-1.

Table A-5-2 shows the populations served by individual systems. Individual systems are septic tanks or small package plants.

In general, these subdistricts would become totally additive in the event of regional consolidation. Some of the 1980 area that is shown as served individually could become tributary to a sewerage district in the future. The tributary area of the subdistricts has been based on discussions with the various agencies dealing with the planning for the study area.


LAKE ERIE
N
EUCLID
WICKLIFFE
EAST CLEVELAND
SOUTH EUCLID
CLEVELAND EASTERLY
CLEVELAND HEIGHTS
LYNDHURST
Mayfield Heights
UNIVERSITY HEIGHTS
SHAKER HEIGHTS
BAY VILLAGE
ROCKY RIVER
LAKEWOOD
CLEVELAND WESTERLY
CLEVELAND
WESTLAKE
Brooklyn
GARFIELD HEIGHTS
MAPLE HEIGHTS
BEDFORD HTS
BEDFORD
SOLON CENTRAL
NORTH OLMSTED
ROCKY RIVER
BROOK PARK
PARMA HEIGHTS
PARMA
CUYAHOGA
OLMSTED
Olmsted Falls
BEREA
MIDDLEBURG HEIGHTS
CLEVELAND SOUTHERLY
STRONGSVILLE
SAGAMORE HILLS
GREENWOOD
TWINSBURG
NORTH OLMSTED
COLUMBIA
NORTH ROYALTON
MEDINA CO
CUYAHOGA
COUNTY
MACEDONIA
LIVERPOOL
HINCKLEY
RICHFIELD
BRUNSWICK HILLS
BOSTON
HUDSON SD 6
MEDINA COUNTY SD 400
LIVERPOOL
GRANGER
YORK
MEDINA
NORTHAMPTON
BATH
GRAFTON


WILLOUGHBY
EUCLID
KIRTLAND
CHARDON
HAMBDEN
CHAGRIN
RIVER
CHESTER
MUNSON
CLARION
SOUTH EUCLID
EASTERLY
LYNDHURST
Mayfield Heights
FAIRMOUNT ROAD
NEWBURY
BURTON
MIDDLEFIELD
RUSSELL
CHAGRIN FALLS
BEDFORD HTS
SOLON CENTRAL
SOLON NORTHEAST
MCFARLAND CREEK
AURORA
AURORA WESTERLY
AURORA CENTRAL
MANTUA
HIRAM
TWINSBURG
MACEDONIA
STREETSBORO
SHALERSVILLE
HUDSON
HUDSON SD 6
TWIN LAKES
FISH CR
RAVENNA
Ravenna



HAVENS AND EMERSON, LTD.

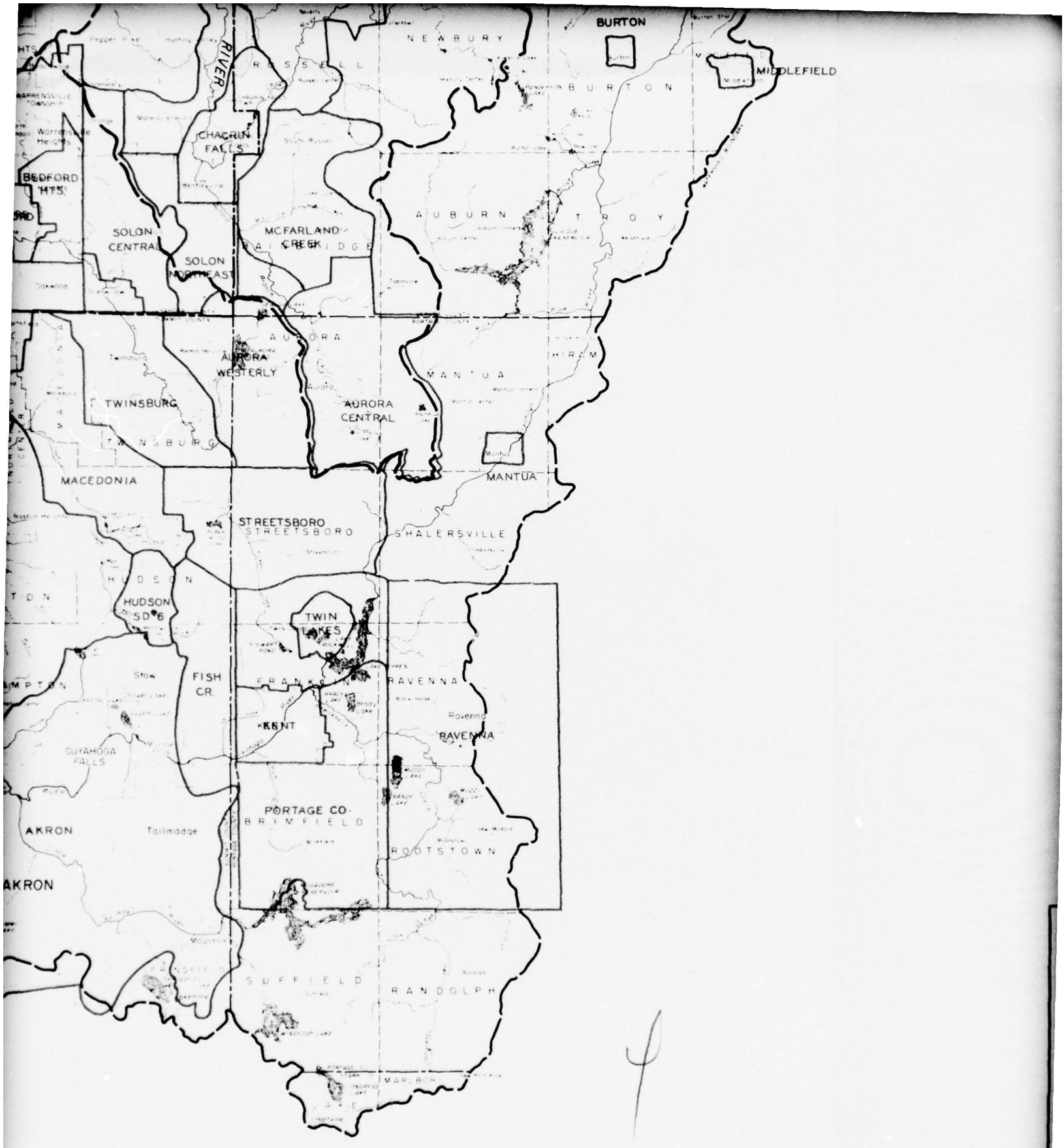

BURTON
NEWBURY
MIDDLEFIELD
RUSSELL
BURTON
CHAGRIN FALLS
BEDFORD HTS.
SOLON CENTRAL
SOLON NORTHEAST
MCFARLAND CREEK
AUBURN
TROY
AURORA
AURORA WESTERLY
HIRAM
MANTUA
TWINSBURG
AURORA CENTRAL
MANTUA
MACEDONIA
STREETSBORO
STREETSBORO
SHALERSVILLE
HUDSON
HUDSON SD 6
TWIN LAKES
FISH CR.
FRANKLIN
RAVENNA
KENT
Ravenna
RAVENNA
CUYAHOGA FALLS
PORTAGE CO.
BRIMFIELD
AKRON
Tallmadge
ROOTSTOWN
AKRON
SUFFIELD
RANDOLPH

FIGURE-A-5-1

SURVEY SCOPE STUDY

WASTE WATER MANAGEMENT PROGRAM

CLEVELAND-AKRON METROPOLITAN AND THREE RIVERS WATERSHED AREAS

U. S. ARMY ENGINEER DISTRICT, BUFFALO

1980 SEWERAGE DISTRICTS

TABLE A-5-1

POPULATIONS IN SEWERAGE

ROCKY RIVER WATE

	TOTAL AREA WITHIN S.D	POP WITHIN S.D. 1970 BASED ON 1970 CENSUS	POP WITHIN S.D. 1970 SERVED BY SEWERS FROM S.D		TOTAL AREA WITHIN S.D	POP WITHIN S.D. 1980 BASED ON	POP WITHIN S.D. 1980 SERVED BY SEWERS FROM S.D		TOTAL AREA WITHIN S.D	POP WITHIN S.D. 1990 BASED ON	POP WITHIN S.D. 1990 SERVED BY SEWERS FROM S.D	
	%	POP.	%	POP.	%	POP	%	POP	%	POP	%	POP
MEDINA COUNTY S.D 400												
MEDINA - CITY	100	10,828	80	8,660	100	15,800	100	15,800	100	21,700	100	21,700
BRUNSWICK	40	14,265	80	11,400	40	27,000	100	27,000	40	34,200	100	34,200
BRUNSWICK HILLS TWP.	40	2,061	15	309	40	2,880	50	1,440	40	3,640	70	2,580
GRANGER TWP.	60	1,784	0	0	60	1,620	0	0	60	2,220	40	888
HINCKLEY TWP.	15	631	60	378	15	795	60	477	15	1,045	80	836
MEDINA TWP.	100	2,445	0	0	100	4,000	15	600	100	5,300	25	1,326
MONTVILLE TWP.	70	1,749	0	0	70	2,800	20	560	70	3,780	30	1,133
YORK TWP.	100	1,729	0	0	100	2,500	10	250	100	3,300	20	660
LAFAYETTE TWP.	5	123	0	0	5	155	0	0	5	215	10	21
SHARON TWP.	4	111	0	0	4	140	0	0	4	192	0	0
LIVERPOOL TWP.	100	2,826	5	141	100	4,700	30	1,200	100	6,900	40	2,760
LITCHFIELD TWP.	10	133	0	0	10	170	0	0	10	230	0	0
		38,190		20,888		62,060		47,387		82,822		66,164
MEDINA COUNTY S.D (HINCKLEY)												
STRONGSVILLE	5	758	0	0	5	1,020	100	1,020	5	1,265	100	1,265
BRUNSWICK HILLS TWP.	10	229	50	114	10	320	100	320	10	410	100	410
BRUNSWICK	10	1,585	100	1,585	10	3,000	100	3,000	10	3,800	100	3,800
HINCKLEY TWP.	30	1,262	10	126	30	1,590	60	795	30	2,190	100	2,190
NORTH ROYALTON	8	1,022	0	0	8	1,289	50	645	8	1,544	100	1,544
BROADVIEW HGTS.	19	2,177	0	0	19	2,962	50	1,481	19	3,666	100	3,666
BRECKSVILLE	5	456	0	0	5	710	50	355	5	910	100	910
		7,489		1,825		10,891		7,616		13,785		13,785
NORTH ROYALTON "A"	45	5,765	43	2,484	45	7,250	70	5,075	45	8,685	100	8,685
STRONGSVILLE "B"	17	2,600	60	1,500	17	3,465	100	3,465	17	4,300	100	4,300
NORTH ROYALTON "B"	23	2,448	100	2,448	23	3,704	100	3,704	23	4,444	100	4,444
STRONGSVILLE "C"	15	2,280	53	1,200	15	3,060	100	3,060	15	3,749	100	3,749
BEREA	100	27,346	100	27,346	100	27,600	100	27,600	100	33,000	100	33,000
NORTH OLMSTED S.D												
NORTH OLMSTED	100	34,861	100	34,861	100	44,000	100	44,000	100	61,500	100	61,500
FAIRVIEW PARK	18	4,000	100	4,000	18	4,855	100	4,855	18	5,800	100	5,800
STRONGSVILLE "A"	63	9,600	68	6,500	63	12,860	100	12,860	63	15,230	100	15,230
OLMSTED TWP	100	6,318	0	0	100	5,800	40	2,321	100	5,800	80	4,640
OLMSTED FALLS (WESTVIEW)	100	2,523	0	0	100	3,500	30	1,050	100	4,500	60	2,580
COLUMBIA TWP.	45	5,451	0	0	45	5,749	10	580	45	6,269	15	940
		62,753		45,361		81,814		70,666		89,535		91,390
MIDDLEBURG HGTS	100	12,367	100	12,367	100	16,500	100	16,500	100	20,300	100	20,300
BROOK PARK	33	16,400	100	16,400	33	23,700	100	23,700	33	29,800	100	29,800
LAKEWOOD												
LAKEWOOD	100	70,173	100	70,173	100	79,500	100	79,500	100	90,820	100	90,820
CLEVELAND	1.33	10,000	100	10,000		12,000	100	12,000		14,000	100	14,000
ROCKY RIVER	2	459	100	459	2	560	100	560	2	used	100	used
		80,632		80,632		91,860		91,860		105,464		105,464

BLE A-5-1

SEWERAGE DISTRICTS

R WATERSHED

POP WITHIN S.D. 1990 BASED ON		POP WITHIN S.D. 1990 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 2000 BASED ON		POP WITHIN S.D. 2000 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 2010 BASED ON		POP WITHIN S.D. 2010 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 2020 BASED ON		POP WITHIN S.D. 2020 SERVED BY SEWERS FROM S.D.
POP	%	POP		%	POP	%	POP		%	POP	%	POP		%	POP	%	POP
21,700	100	21,700		100	27,600	100	27,600		100	32,600	100	32,600		100	36,400	100	36,400
34,200	100	34,200		90	37,800	100	37,800		90	43,200	100	43,200		90	50,460	100	50,460
5,040	70	2,580		90	4,500	100	4,500		90	5,310	100	5,310		90	5,850	100	5,850
2,220	40	888		60	2,820	60	1,692		60	3,300	60	1,980		60	3,660	60	2,196
1,045	80	876		15	1,380	90	1,242		15	1,636	100	1,636		15	1,800	100	1,800
5,300	25	1,326		100	6,400	40	2,560		100	7,500	60	4,500		100	9,000	80	7,200
3,780	30	1,133		70	4,480	50	2,240		70	5,180	70	3,626		70	5,880	100	5,880
3,300	20	660		100	4,000	40	1,600		100	4,800	60	2,880		100	5,200	80	4,160
215	10	21		5	270	20	54		5	315	20	63		5	350	20	70
192	0	0		4	240	10	24		4	284	10	28		4	312	20	62
6,900	40	2,760		100	7,800	50	3,900		100	8,600	60	5,160		100	9,200	70	6,440
230	0	0		10	240	0	0		10	340	0	0		10	380	0	0
82,822		66,144			97,580		83,212			113,065		100,983			128,482		120,508
1,265	100	1,265		5	1,435	100	1,435		5	1,530	100	1,530		5	1,540	100	1,540
410	100	410		10	500	100	500		10	540	100	540		10	650	100	650
3,800	100	3,800		10	4,200	100	4,200		10	4,800	100	4,800		10	5,600	100	5,600
2,140	100	2,140		30	2,760	100	2,760		30	3,270	100	3,270		30	3,600	100	3,600
1,584	100	1,584		8	1,737	100	1,737		8	1,840	100	1,840		8	1,840	100	1,840
3,666	100	3,666		19	4,165	100	4,165		19	4,450	100	4,450		19	4,480	100	4,480
810	100	810		5	1,015	100	1,015		5	1,105	100	1,105		5	1,130	100	1,130
13,785		13,785			15,812		15,812			17,585		17,585			18,840		18,840
8,685	100	8,685		45	9,760	100	9,760		45	10,350	100	10,350		45	10,350	100	10,350
4,500	100	4,500		17	4,880	100	4,800		17	5,200	100	5,200		17	5,240	100	5,240
4,444	100	4,444		23	4,441	100	4,441		23	5,240	100	5,240		23	5,290	100	5,290
3,799	100	3,799		15	4,305	100	4,305		15	4,595	100	4,595		15	4,620	100	4,620
33,000	100	33,000		100	36,400	100	36,900		100	39,100	100	39,100		100	39,100	100	39,100
61,500	100	61,500		100	70,300	100	70,300		100	75,200	100	75,200		100	75,700	100	75,700
5,800	100	5,800		18	6,480	100	6,480		18	6,840	100	6,840		18	6,850	100	6,850
15,130	100	15,230		63	18,090	100	18,090		63	19,240	100	19,240		63	19,400	100	19,400
5,800	80	4,640		100	6,000	100	6,000		100	6,000	100	6,000		100	6,000	100	6,000
4,300	60	2,580		100	4,900	100	4,900		100	5,200	100	5,200		100	5,300	100	5,300
6,265	15	940		95	6,455	20	1,240		95	6,555	30	1,968		95	6,360	40	2,543
49,515		41,390			112,225		107,060			114,085		114,498			119,610		115,743
20,300	100	20,300		100	23,000	100	23,000		100	24,500	100	24,500		100	24,600	100	24,600
29,800	100	29,800		33	34,200	100	34,200		33	36,500	100	36,500		33	36,800	100	36,800
90,800	100	90,800		100	99,500	100	99,500		100	104,300	100	104,300		100	104,000	100	104,000
14,000	100	14,000			16,000	100	16,000			18,000	100	18,000			20,000	100	20,000
664	100	664		2	740	100	740		2	782	100	782		2	784	100	784
105,464		105,464			116,240		116,240			123,082		123,082			124,784		124,784

LAKE ERIE

	TOTAL AREA WITHIN S.D.	POP WITHIN S.D. - 1970 BASED ON 1970 CENSUS	POP WITHIN S.D. - 1970 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 1980 BASED ON	POP WITHIN S.D. 1980 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP WITHIN S.D. - 1990 BASED ON	POP WITHIN S.D. 1990 SERVED BY SEWERS FROM S.D.	
	%	POP.	%	POP.	%	POP	%	POP	%	POP	%	POP
ROCKY RIVER S.D.												
BAY VILLAGE	100	18,163	100	18,163	100	22,200	100	22,200	100	24,000	100	24,000
WESTLAKE	100	15,686	20	3,136	100	22,000	80	17,600	100	24,000	100	24,000
ROCKY RIVER	98	22,458	100	22,458	98	27,400	100	27,400	98	32,500	100	32,500
FAIRVIEW PARK	82	17,781	100	17,781	82	22,140	100	22,140	82	26,400	100	26,400
		74,088		61,537		93,740		89,340		111,900		111,900
WESTERLY												
CLEVELAND	21.24	160,000	100	160,000		151,000	100	151,000		151,000	100	151,000
EASTERLY												
CLEVELAND	30.3	227,900	100	227,900	30.3	223,900	100	223,900	30.3	238,700	100	238,700
BRATENAHL	100	1,613	100	1,613	100	3,000	100	3,000	100	5,000	100	5,000
EAST CLEVELAND	100	39,600	100	39,600	100	44,100	100	44,100	100	50,200	100	50,200
CLEVELAND HGTS.	100	60,767	100	60,767	100	66,200	100	66,200	100	74,200	100	74,200
SHAKER HGTS.	85	30,840	100	30,840	85	33,820	100	33,820	85	38,100	100	38,100
BEACHWOOD	52	5,015	50	2,508	52	6,550	100	6,550	52	8,005	100	8,005
SOUTH EUCLID	100	29,579	100	29,579	100	33,800	100	33,800	100	38,800	100	38,800
UNIVERSITY HGTS.	100	17,055	100	17,055	100	18,000	100	18,000	100	20,300	100	20,300
LYNDHURST	100	14,749	100	14,749	100	23,500	100	23,500	100	27,500	100	27,500
MAYFIELD HGTS.	100	22,134	50	11,064	100	29,200	80	23,390	100	35,800	100	35,800
HIGHLAND HGTS.	100	5,426	100	5,926	100	8,300	100	8,300	100	10,300	100	10,300
PEPPER PIKE	100	5,933	20	1,187	100	6,500	40	2,600	100	8,100	70	5,670
WOODMERE	100	976	10	98	100	1,500	50	750	100	1,900	100	1,900
MAYFIELD	53	1,882	50	941	53	2,545	70	1,782	53	3,125	100	3,125
GATES MILLS	60	1,427	10	143	60	1,800	30	540	60	2,220	80	1,776
HUNTING VALLEY	60	404	10	40	60	720	30	216	60	1,200	80	960
MORELAND HILLS	20	600	10	60	20	780	30	234	20	900	80	720
WILLOUGHBY HILLS	40	2,048	10	210	40	7,800	30	840	40	3,760	80	3,010
RICHMOND HGTS.	85	7,835	70	5,480	85	10,240	100	10,240	85	12,670	100	12,670
		481,338		454,765		517,305		501,812		580,860		576,816
EUCLID												
EUCLID	100	71,522	100	71,522	100	84,500	100	84,500	100	98,400	100	98,400
WICKLIFFE	100	21,354	100	21,354	100	29,400	100	29,400	100	40,000	100	40,000
WILLOWICK	100	21,237	100	21,237	100	26,900	100	26,900	100	34,800	100	34,800
RICHMOND HGTS.	15	1,882	70	967	15	1,818	100	1,818	15	2,239	100	2,239
		115,525		115,110		142,618		142,618		175,439		175,439
WILLOUGHBY - EASTLAKE												
EASTLAKE	100	19,640	100	19,640	100	26,600	100	26,600	100	41,800	100	41,800
WILLOUGHBY	100	18,634	100	18,634	100	24,700	100	24,700	100	32,400	100	32,400
TIMBERLAKE	100	464	0	0	100	1,300	50	650	100	1,800	100	1,800
LAKELINE	100	223	0	0	100	300	50	150	100	400	100	400
		39,511		38,324		52,900		52,100		76,400		76,400

KE ERIE

TOTAL AREA WITHIN S D	POP WITHIN S D 1990 BASED ON	POP WITHIN S D 1990 SERVED BY SEWERS FROM S D		TOTAL AREA WITHIN S D	POP WITHIN S D 2000 BASED ON	POP WITHIN S D 2000 SERVED BY SEWERS FROM S D		TOTAL AREA WITHIN S D	POP WITHIN S D 2010 BASED ON	POP WITHIN S D 2010 SERVED BY SEWERS FROM S D		TOTAL AREA WITHIN S D	POP WITHIN S D 2020 BASED ON	POP WITHIN S D 2020 SERVED BY SEWERS FROM S D
%	POP	%	POP	%	POP	%	POP	%	POP	%	POP	%	POP	%	POP
100	24,000	100	24,000	100	24,100	100	24,100	100	24,200	100	24,200	100	24,300	100	24,300
100	44,000	100	44,000	100	36,000	100	36,000	100	44,000	100	44,000	100	50,000	100	50,000
48	32,500	100	32,500	48	36,205	100	36,205	48	38,300	100	98,300	48	38,400	100	38,400
82	26,400	100	26,400	82	24,500	100	24,500	82	31,200	100	31,200	82	31,230	100	31,200
	111,900		111,900		125,805		125,805		137,700		137,700		143,930		143,930
	151,000	100	151,000		152,000	100	152,000		153,000	100	153,000		160,000	100	160,000
30.3	238,700	100	238,700	30.3	252,000	100	252,000	30.3	259,500	100	259,500	30.3	256,300	100	256,300
100	5,000	100	5,000	100	6,000	100	6,000	100	7,000	100	7,000	100	8,000	100	8,000
100	50,200	100	50,200	100	54,900	100	54,900	100	57,400	100	57,400	100	57,200	100	57,200
100	74,200	100	74,200	100	80,500	100	80,500	100	83,300	100	83,300	100	83,500	100	83,500
85	38,150	100	38,100	85	41,500	100	41,500	85	43,450	100	43,450	85	43,150	100	43,150
52	8,005	100	8,005	52	9,049	100	9,049	52	9,620	100	9,620	52	9,670	100	9,670
100	38,800	100	38,800	100	42,600	100	42,600	100	44,600	100	44,600	100	44,500	100	44,500
100	20,300	100	20,300	100	22,000	100	22,000	100	23,000	100	23,000	100	22,800	100	22,800
100	27,500	100	27,500	100	30,500	100	30,500	100	32,100	100	32,100	100	32,100	100	32,100
100	35,800	100	35,800	100	40,500	100	40,500	100	43,100	100	43,100	100	43,300	100	43,300
100	10,300	100	10,300	100	11,800	100	11,800	100	12,600	100	12,600	100	12,700	100	12,700
100	8,100	70	5,670	100	9,400	100	9,400	100	10,900	100	10,900	100	11,000	100	11,000
100	1,900	100	1,900	100	2,200	100	2,200	100	2,400	100	2,400	100	2,400	100	2,400
53	3,125	100	3,125	53	3,554	100	3,554	53	3,818	100	3,818	53	3,818	100	3,818
60	2,220	80	1,776	60	2,460	100	2,460	60	2,640	100	2,640	60	2,640	100	2,640
60	1,200	80	960	60	1,440	100	1,440	60	1,680	100	1,680	60	1,920	100	1,920
20	900	80	720	20	1,000	100	1,000	20	1,060	100	1,060	20	1,060	100	1,060
40	3,760	80	3,010	40	4,680	100	4,680	40	5,520	100	5,520	40	6,045	100	6,045
85	12,670	100	12,670	85	14,450	100	14,450	85	15,400	100	15,400	85	15,470	100	15,470
	580,860		576,816		630,533		630,533		659,688		659,688		657,573		657,573
100	98,400	100	98,400	100	108,700	100	108,700	100	114,400	100	114,400	100	114,300	100	114,300
100	40,000	100	40,000	100	50,500	100	50,500	100	59,600	100	59,600	100	65,500	100	65,500
100	34,800	100	34,800	100	42,800	100	42,800	100	49,400	100	49,400	100	54,500	100	54,500
15	2,234	100	2,234	15	2,550	100	2,550	15	2,717	100	2,717	15	2,730	100	2,730
	175,434		175,434		204,550		204,550		226,617		226,617		237,030		237,030
100	41,800	100	41,800	100	53,600	100	53,600	100	63,800	100	63,800	100	70,400	100	70,400
100	32,400	100	32,400	100	41,000	100	41,000	100	48,200	100	48,200	100	52,800	100	52,800
100	1,800	100	1,800	100	2,200	100	2,200	100	2,600	100	2,600	100	2,400	100	2,400
100	400	100	400	100	500	100	500	100	600	100	600	100	700	100	700
	76,400		76,400		97,300		97,300		115,200		115,200		126,800		126,800

CUYAHOGA RIVER W

	TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 1970 BASED ON 1970 CENSUS		POP WITHIN S.D. 1970 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 1980 BASED ON	POP WITHIN S.D. 1980 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 1990 BASED ON	POP WITHIN S.D. 1990 SERVED BY SEWERS FROM S.D.	
	%	POP.	%	POP.		%	POP	%	POP		%	POP	%	POP
MIDDLEFIELD													
MIDDLEFIELD	100	1,770	100	1,770			2,500		2,500			3,600		3,500
MIDDLEFIELD TWP.		2,738		0			3,900		500			5,400		700
		4,508		1,770			6,400		3,000			8,900		4,200
BURTON													
BURTON VILLAGE	100	1,252	87	1,100		100	1,600	100	1,600		100	2,000	100	2,000
BURTON TWP.				0					500					900
				1,100					2,100					2,900
MANTUA													
MANTUA	100	1,199	100	1,199		100	1,400	100	1,400		100	1,600	100	1,600
MANTUA TWP.	85	1,019	24	241		80	1,280	35	450		75	1,650	47	780
		2,218		1,440			2,680		1,850			3,250		2,380
SHALERSVILLE TWP.	60	2,982	100	2,982		60	4,080	100	4,080		60	5,464	100	5,464
TWIN LAKES													
STREETSBORO	8	637	0	0		8	800	100	800		8	1,048	100	1,048
FRANKLIN	11	642	0	0		11	880	100	880		11	1,178	100	1,178
		1,279		0			1680		1680			2,226		2,226
RAVENNA													
RAVENNA	100	11,800	90	10,620		100	14,000	100	14,000		100	17,300	100	17,300
RAVENNA TWP.	100	8,856	15	1,323		100	12,100	40	4,840		100	16,200	70	11,340
SHALERSVILLE TWP.	30	1,441	0	0		30	2,040	10	204		30	2,732	30	820
ROOTSTOWN TWP.	100	6,010	25	1,502		100	8,200	40	3,280		100	11,000	100	7,700
		28,137		13,445			36,340		22,324			47,232		37,160
KENT	100	28,183	90	25,365		100	40,800	100	40,800		100	56,100	100	56,100
FISH CREEK													
STOW	45	8,935	20	1,786		45	12,000	80	9,600		45	14,680	100	14,680
MUNROE FALLS	20	758	20	152		20	1,100	80	880		20	1,360	100	1,360
HUDSON TWP.	8	356	50	198		8	520	80	416		8	582	100	582
BRIMFIELD TWP.	100	6,721	15	1,008		100	9,200	50	4,600		100	12,300	100	12,300
FRANKLIN TWP.	50	7,551	60	4,535		50	9,450	80	7,555		50	11,150	100	11,150
TALLMADGE	10	1,527	0	0		10	1,980	50	990		10	2,340	100	2,340
		25,848		7,659			34,250		24,041			42,462		42,462
HUDSON S.D. 6													
HUDSON TWP.	40	1,800	100	1,800		40	2,600	100	2,600		40	2,920	100	2,920
STOW		3,060		3,060			6,240		6,240			8,580		8,580
		4,860		4,860			8,840		8,840			11,500		11,500
AKRON													
NORTHAMTON TWP.	60	3,300	50	1,650		60	4,260	100	4,260		60	5,045	100	5,045
AKRON	100	274,500	100	274,500		100	290,100	100	290,100		100	318,000	100	318,000
STOW		7,065	90	6,358			7,386		7,386			8,056		8,056
FAIRLAWN	50	3,051	100	3,051		50	4,300	100	4,300		50	5,350	100	5,350
CUYAHOGA FALLS	100	49,678	100	49,678		100	55,400	100	55,300		100	63,000	100	63,000
SILVER LAKE	100	3,637	100	3,637		100	4,000	100	4,000		100	4,200	100	4,200
MUNROE FALLS	70	2,669	80	2,124		70	3,847	100	3,847		70	4,760	100	4,760
MOGADORE	90	2,881	50	1,440		90	2,788	75	2,041		90	2,880	100	2,880
TALLMADGE	82	1,252	50	626		82	1,623	75	1,217		82	1,960	100	1,960
LAKEMORE	20	542	50	271		20	600	75	450		20	660	100	660
SPRINGFIELD	15	2,540	50	1,270		15	3,180	75	2,380		15	3,750	100	3,750
BATH TWP.	4	302	50	151		4	376	75	282		4	444	100	444
SUFFIELD	1	58	70	41		1	79	100	79		1	106	100	106
		351,465		344,747			378,434		376,242			418,211		418,211

IVER WATERSHED

TOTAL AREA WITHIN S D	POP WITHIN S D - 1990 BASED ON	POP WITHIN S D - 1990 SERVED BY SEWERS FROM S D		TOTAL AREA WITHIN S D	POP WITHIN S D - 2000 BASED ON	POP WITHIN S D - 2000 SERVED BY SEWERS FROM S D		TOTAL AREA WITHIN S D	POP WITHIN S D - 2040 BASED ON	POP WITHIN S D - 2040 SERVED BY SEWERS FROM S D		TOTAL AREA WITHIN S D	POP WITHIN S D - 2020 BASED ON	POP WITHIN S D - 2020 SERVED BY SEWERS FROM S D	
%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.
	3,600		3,500		4,500		4,500		5,500		5,500		6,200		6,200
	5,400		700		7,200		1,000		8,800		1,500		9,900		2,000
	8,900		4,200		11,700		5,500		14,300		7,000		16,100		8,200
100	2,000	100	2,000	100	2,600	100	2,600	100	3,100	100	3,100	100	3,500	100	3,500
			400				400				1,100				1,600
			2,400				3,500				4,200				5,100
100	1,600	100	1,600	100	1,900	100	1,900	100	2,200	100	2,200	100	2,400	100	2,400
75	1,650	47	780	70	1,960	53	1,040	65	2,080	68	1,420	45	1,575	100	1,575
	3,250		2,380		3,860		2,940		4,280		3,620		3,975		3,975
60	5,464	100	5,464	60	6,900	100	6,900	60	8,040	100	8,040	60	8,850	100	8,850
8	1,048	100	1,048	8	1,320	100	1,320	8	1,543	100	1,543	8	1,697	100	1,697
11	1,178	100	1,178	11	1,485	100	1,485	11	1,739	100	1,739	11	1,892	100	1,892
	2,226		2,226		2,805		2,805		3,282		3,282		3,589		3,589
100	17,300	100	17,300	100	20,900	100	20,900	100	24,100	100	24,100	100	26,100	100	26,100
100	16,200	70	11,340	100	20,400	100	20,400	100	23,900	100	23,900	100	26,100	100	26,100
30	2,732	30	820	30	3,450	100	3,450	30	4,020	100	4,020	30	4,415	100	4,415
100	11,000	100	7,700	100	13,900	100	13,900	100	16,200	100	16,200	100	17,700	100	17,700
	47,232		37,160		58,650		58,650		68,220		68,220		74,315		74,315
100	56,100	100	56,100	100	71,900	100	71,900	100	85,100	100	85,100	100	93,700	100	93,700
45	14,680	100	14,680	45	16,700	100	16,700	45	17,820	100	17,820	45	18,200	100	18,200
20	1,360	100	1,360	20	1,580	100	1,580	20	1,680	100	1,680	20	1,720	100	1,720
8	582	100	582	8	624	100	624	8	860	100	860	8	910	100	910
100	12,300	100	12,300	100	15,500	100	15,500	100	18,200	100	18,200	100	19,200	100	19,800
50	11,150	100	11,150	50	12,500	100	12,500	50	13,250	100	13,250	50	13,350	100	13,350
10	2,340	100	2,340	10	2,100	100	2,700	10	2,880	100	2,880	10	2,920	100	2,920
	42,462		42,462		54,604		54,604		54,640		54,640		56,900		56,900
40	2,920	100	2,920	40	3,120	100	3,120	40	3,440	100	3,440	40	3,940	100	3,940
	8,580		8,580		10,480		10,980		14,160		14,160		16,660		16,660
	11,500		11,500		14,100		14,100		17,600		17,600		20,600		20,600
60	5,045	100	5,045	60	5,645	100	5,645	60	6,000	100	6,000	60	6,060	100	6,060
100	318,000	100	318,000	100	343,700	100	343,700	100	357,700	100	357,700	100	359,400	100	359,400
	8,056		8,056		7,948		7,948		8,038		8,038		5,964		5,964
50	5,350	100	5,350	50	6,150	100	6,150	50	6,550	100	6,550	50	6,700	100	6,700
100	63,000	100	63,000	100	69,100	100	69,100	100	72,400	100	72,400	100	73,000	100	73,000
100	4,200	100	4,200	100	4,400	100	4,400	100	4,400	100	4,400	100	4,400	100	4,400
70	4,760	100	4,760	70	5,530	100	5,530	70	5,880	100	5,880	70	6,020	100	6,020
90	2,880	100	2,880	90	3,060	100	3,060	90	3,148	100	3,148	90	3,148	100	3,148
82	1,960	100	1,960	82	2,217	100	2,217	82	2,361	100	2,361	82	2,347	100	2,347
20	660	100	660	20	720	100	720	20	760	100	760	20	760	100	760
15	3,750	100	3,750	15	4,200	100	4,200	15	4,440	100	4,440	15	4,485	100	4,485
4	444	100	444	4	500	100	500	4	528	100	528	4	536	100	536
1	106	100	106	1	134	100	134	1	156	100	156	1	171	100	171
	418,211		418,211		453,304		453,304		470,361		470,361		471,041		471,041

CUYAHOGA RIVER WATE

	TOTAL AREA WITHIN S.D.	POP. WITHIN S.D. - 1970 BASED ON 1970 CENSUS	POP. WITHIN S.D. - 1970 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP. WITHIN S.D. - 1980 BASED ON	POP. WITHIN S.D. - 1980 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP. WITHIN S.D. - 1990 BASED ON	POP. WITHIN S.D. - 1990 SERVED BY SEWERS FROM S.D.	
	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.
MACEDONIA												
HUDSON CITY (INCL. WTR. PLANT WASTE.)	100	3,933	100	3,933	100	5,500	100	5,500	100	7,100	100	7,100
BOSTON HGTS.	90	762	0	0	90	900	40	360	90	990	60	595
NORTHFIELD CENTER TWP.	60	2,370	40	949	60	4,200	100	4,200	60	6,600	100	6,600
MACEDONIA	90	5,745	70	4,015	90	7,650	100	7,650	90	9,270	100	9,270
HUDSON TWP.	25	1,118	15	167	25	1,624	70	1,138	25	1,824	100	1,824
TWINSBURG TWP.	20	283	0	0	20	360	0	0	20	420	40	168
		14,211		9,064		20,234		18,848		26,204		25,557
GREENWOOD												
SAGAMORE HILLS	40	2,683	100	2,683	40	4,000	100	4,000	40	5,200	100	5,200
NORTHFIELD CENTER TWP.	8	316	100	316	8	560	100	560	8	880	100	880
		2,999		2,999		4,560		4,560		6,080		6,080
STREETSBORO												
STREETSBORO	85	6,774	60	4,065	85	8,500	90	7,650	85	11,135	100	11,135
HUDSON TWP.	20	893	80	714	20	1,300	100	1,300	20	1,460	100	1,460
		7,667		4,779		9,800		8,950		12,595		12,595
AURORA WESTERLY												
AURORA	60	3,922	40	1,570	60	5,820	100	5,820	60	8,040	100	8,040
TWINSBURG TWP.	20	283	0	0	20	360	60	216	20	420	100	420
REMINDERVILLE	100	215	0	0	100	4,000	100	4,000	100	6,000	100	6,000
SOLON	5	577	0	0	5	785	50	392	5	975	100	975
BAINBRIDGE TWP.	3	211	0	0	3	300	0	0	3	435	30	130
		5,208		1,570		11,265		10,428		15,870		15,565
TWINSBURG												
TWINSBURG	100	6,432	100	6,432	100	8,600	100	8,600	100	10,400	100	10,400
TWINSBURG TWP.	60	849	0	0	60	1,080	50	540	60	1,260	100	1,260
MACEDONIA	10	637	0	0	10	850	0	0	10	1,030	100	1,030
		7,918		6,432		10,530		9,140		12,690		12,690
SOLON CENTRAL												
SOLON		8,250		8,250		10,720		10,720		12,925		12,925
BEDFORD HGTS.												
BEDFORD HGTS.	100	13,063	100	13,063	100	19,200	100	19,200	100	24,400	100	24,400
OAKWOOD	10	313	50	156	10	300	60	180	10	330	80	264
WARRENSVILLE HGTS.	10	1,892	0	0	10	2,560	80	2,047	10	3,160	100	3,160
		15,268		13,219		22,060		21,427		27,890		27,824
BEDFORD	100	17,552	100	17,552	100	20,500	100	20,500	100	23,900	100	23,900
RICHFIELD	100	4,943	0	0	100	7,800	70	5,560	100	11,100	80	8,880

ER WATERSHED (CONT'D)

	TOTAL AREA WITHIN S.D.	POP. WITHIN S.D. - 1990 BASED ON	POP. WITHIN S.D. - 1990 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP. WITHIN S.D. - 2000 BASED ON	POP. WITHIN S.D. - 2000 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP. WITHIN S.D. - 2010 BASED ON	POP. WITHIN S.D. - 2010 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP. WITHIN S.D. - 2020 BASED ON	POP. WITHIN S.D. - 2020 SERVED BY SEWERS FROM S.D.	
	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.
	100	7,100	100	7,100	100	8,700	100	8,700	100	9,100	100	9,100	100	10,000	100	10,000
	90	990	60	595	90	1,080	100	1,080	90	1,170	100	1,170	90	1,170	100	1,170
	60	6,600	100	6,600	60	7,800	100	7,800	60	9,000	100	9,000	60	10,200	100	10,200
	90	9,270	100	9,270	90	10,530	100	10,530	90	11,250	100	11,250	90	11,420	100	11,420
	25	1,824	100	1,824	25	1,950	100	1,950	25	2,149	100	2,149	25	2,276	100	2,276
	20	420	40	168	20	460	100	460	20	500	100	500	20	500	100	500
		26,204		25,557		30,520		30,520		33,169		33,169		35,566		35,566
	40	5,200	100	5,200	40	7,200	100	7,200	40	8,400	100	8,400	40	8,800	100	8,800
	8	880	100	880	8	1,040	100	1,040	8	1,200	100	1,200	8	1,360	100	1,360
		6,080		6,080		8,240		8,240		9,600		9,600		10,160		10,160
	85	11,135	100	11,135	85	14,025	100	14,025	85	16,400	100	16,400	85	18,030	100	18,030
	20	1,460	100	1,460	20	1,560	100	1,560	20	1,720	100	1,720	20	1,820	100	1,820
		12,595		12,595		15,585		15,585		18,120		18,120		19,850		19,850
	60	8,040	100	8,040	60	10,320	100	10,320	60	12,230	100	12,230	60	13,500	100	13,500
	20	420	100	420	20	460	100	460	20	500	100	500	20	500	100	500
	100	6,000	100	6,000	100	8,000	100	8,000	100	10,000	100	10,000	100	10,000	100	10,000
	5	975	100	975	5	1,110	100	1,110	5	1,180	100	1,180	5	1,190	100	1,190
	3	435	30	130	3	582	100	582	3	711	100	711	3	805	100	805
		15,870		15,565		20,472		20,472		24,621		24,621		25,495		25,495
	100	10,400	100	10,400	100	11,900	100	11,900	100	12,700	100	12,700	100	12,900	100	12,900
	60	1,260	100	1,260	60	1,380	100	1,380	60	1,500	100	1,500	60	1,500	100	1,500
	10	1,030	100	1,030	10	1,170	100	1,170	10	1,250	100	1,250	10	1,270	100	1,270
		12,690		12,690		14,450		14,450		15,450		15,450		15,670		15,670
		12,925		12,925		14,190		14,190		13,820		13,820		12,600		12,600
	100	24,400	100	24,400	100	28,100	100	28,100	100	30,100	100	30,100	100	30,300	100	30,300
	10	330	80	264	10	340	100	340	10	350	100	350	10	340	100	340
	10	3,160	100	3,160	10	3,590	100	3,590	10	3,830	100	3,830	10	3,850	100	3,850
		27,890		27,824		32,030		32,030		34,280		34,280		34,490		34,490
	100	23,900	100	23,900	100	26,400	100	26,400	100	27,800	100	27,800	100	27,800	100	27,800
	100	11,100	80	8,880	100	11,800	90	10,620	100	12,700	90	11,430	100	13,500	90	12,150

CUYAHOGA RIVER WATER

	TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 1970 BASED ON 1970 CENSUS	POP WITHIN S.D. 1970 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 1980 BASED ON	POP WITHIN S.D. 1980 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 1990 BASED ON	POP WITHIN S.D. 1990 SERVED BY SEWERS FROM S.D.	
	%	POP	%	POP	%	POP	%	POP	%	POP	%	POP
SOUTHERLY												
OAKWOOD	90	2,845	20	569	90	2,700	60	1,620	90	2,972	100	2,972
NORTHFIELD VILLAGE	100	3,870	100	3,870	100	4,100	100	4,100	100	4,500	100	4,500
WALTON HILLS	100	2,503	20	501	100	3,500	60	2,100	100	4,200	100	4,200
VALLEY VIEW	100	1,422	0	0	100	2,000	40	800	100	2,400	60	1,440
GARFIELD HGTS.	100	41,417	100	41,417	100	47,200	100	47,200	100	54,200	100	54,200
INDEPENDENCE	100	7,034	20	1,407	100	9,000	100	9,000	100	12,000	100	12,000
SEVEN HILLS	100	12,700	100	12,700	100	18,300	100	18,300	100	23,000	100	23,000
NORTHFIELD CENTER TWP.	7	276	0	0	7	440	0	0	7	770	100	770
BROADVIEW HGTS.	81	9,270	30	2,780	81	12,630	60	7,580	81	15,630	100	15,630
NORTH ROYALTON	24	3,017	0	0	24	3,863	60	2,318	24	4,635	100	4,635
BRECKSVILLE	90	8,220	100	8,220	90	12,780	100	12,780	90	16,380	100	16,380
SAGAMORE HILLS	60	4,035	50	2,013	60	6,000	100	6,000	60	7,800	100	7,800
BROOKLYN HGTS.	100	1,527	100	1,527	100	1,700	100	1,700	100	1,400	100	1,400
MAPLE HGTS.	100	34,100	100	34,100	100	39,100	100	39,100	100	45,000	100	45,000
RIVEREDGE TWP.	100	632	100	632	100	600	100	600	100	600	100	600
BROOK PARK		14,340	100	14,340		19,225	100	19,225		24,335	100	24,335
PARMA HGTS.	100	27,192	100	27,192	100	34,000	100	34,000	100	41,200	100	41,200
PARMA	100	100,216	100	100,216	100	120,000	100	120,000	100	141,200	100	141,200
BROOKLYN	100	13,142	100	13,142	100	15,800	100	15,800	100	18,700	100	18,700
NEWBURG HGTS.	100	3,396	100	3,396	100	3,600	100	3,600	100	4,100	100	4,100
CUYAHOGA HGTS.	100	866	100	866	100	1,000	100	1,000	100	1,100	100	1,100
NORTH RANDALL	100	1,212	100	1,212	100	1,600	100	1,600	100	2,000	100	2,000
CLEVELAND	47.1	354,000	100	354,000	47.1	347,900	100	347,900	47.1	371,500	100	371,500
WARRENSVILLE HGTS.	90	17,050	100	17,050	90	23,030	100	23,030	90	28,460	100	28,460
WARRENSVILLE TWP.	100	2,160	100	2,160	100	2,000	100	2,000	100	2,000	100	2,000
BEACHWOOD	48	4,625	50	2,313	48	6,050	100	6,050	48	7,340	100	7,340
SHAKER HGTS.	15	5,447	100	5,447	15	5,970	100	5,970	15	6,740	100	6,740
LINNDALE	100	145	100	145	100	200	100	200	100	200	100	200
ORANGE	100	2,112	0	0	100	2,400	20	480	100	2,800	60	1,680
		678,796		651,254		746,738		734,054		847,702		849,622

WATERSHED (CONT'D)

TOTAL AREA WITHIN S.D.	POP. WITHIN S.D. 1990 BASED ON	POP. WITHIN S.D. 1990 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP. WITHIN S.D. 2000 BASED ON	POP. WITHIN S.D. 2000 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP. WITHIN S.D. 2010 BASED ON	POP. WITHIN S.D. 2010 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP. WITHIN S.D. 2020 BASED ON	POP. WITHIN S.D. 2020 SERVED BY SEWERS FROM S.D.	
%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.
90	2,472	100	2,472	90	3,060	100	3,060	90	3,348	100	3,348	90	3,060	100	3,060
100	4,500	100	4,500	100	5,000	100	5,000	100	5,400	100	5,400	100	6,200	100	6,200
100	4,200	100	4,200	100	4,700	100	4,700	100	5,200	100	5,200	100	5,500	100	5,500
100	2,400	60	1,440	100	3,000	100	3,000	100	3,500	100	3,500	100	4,000	100	4,000
100	54,200	100	54,200	100	59,500	100	59,500	100	62,400	100	62,400	100	62,300	100	62,300
100	12,000	100	12,000	100	15,000	100	15,000	100	18,000	100	18,000	100	21,000	100	21,000
100	23,000	100	23,000	100	26,300	100	26,300	100	28,200	100	28,200	100	28,400	100	28,400
7	770	100	770	7	910	100	910	7	1,050	100	1,050	7	1,140	100	1,140
81	15,630	100	15,630	81	17,750	100	17,750	81	18,950	100	18,950	81	19,130	100	19,130
24	4,635	100	4,635	24	5,220	100	5,220	24	5,520	100	5,520	24	5,520	100	5,120
90	16,380	100	16,380	90	18,275	100	18,275	90	19,845	100	19,845	90	20,360	100	20,360
60	7,800	100	7,800	60	10,800	100	10,800	60	12,600	100	12,600	60	13,200	100	13,200
100	1,400	100	1,900	100	2,100	100	2,100	100	2,200	100	2,200	100	2,200	100	2,200
100	45,000	100	45,000	100	49,400	100	49,400	100	51,800	100	51,800	100	51,700	100	51,700
100	600	100	600	100	600	100	600	100	600	100	600	100	600	100	600
	24,335	100	24,335		27,750	100	27,750		29,920	100	29,920		30,070	100	30,070
100	41,200	100	41,200	100	46,400	100	46,400	100	49,400	100	49,400	100	49,400	100	49,400
100	131,200	100	131,200	100	156,800	100	156,800	100	165,300	100	165,300	100	165,400	100	165,400
100	18,700	100	18,700	100	20,800	100	20,800	100	21,900	100	21,900	100	21,900	100	21,900
100	4,100	100	4,100	100	4,400	100	4,400	100	4,600	100	4,600	100	4,500	100	4,500
100	1,100	100	1,100	100	1,200	100	1,200	100	1,200	100	1,200	100	1,200	100	1,200
100	2,000	100	2,000	100	2,300	100	2,300	100	2,400	100	2,400	100	2,500	100	2,500
471	371,500	100	371,500	471	392,000	100	392,000	471	403,500	100	403,500	471	398,500	100	398,500
90	28,450	100	28,450	90	32,300	100	32,300	90	34,460	100	34,460	90	34,650	100	34,650
100	2,000	100	2,000	100	2,000	100	2,000	100	2,000	100	2,000	100	2,000	100	2,000
48	7,340	100	7,340	48	8,350	100	8,350	48	8,880	100	8,880	48	8,950	100	8,950
15	6,740	100	6,740	15	7,325	100	7,325	15	7,640	100	7,640	15	7,600	100	7,600
100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200
100	2,800	60	1,680	100	3,000	100	3,000	100	3,200	100	3,200	100	3,200	100	3,200
	847,702		845,622		926,440		926,440		973,253		973,253		974,410		974,410

CHAGRIN RIVER WA

	TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 1970 BASED ON 1970 CENSUS	POP WITHIN S.D. 1970 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 1980 BASED ON	POP WITHIN S.D. 1980 SERVED BY SEWERS FROM S.D.		TOTAL AREA WITHIN S.D.	POP WITHIN S.D. 1990 BASED ON	POP WITHIN S.D. 1990 SERVED BY SEWERS FROM S.D.	
	%	POP.	%	POP.	%	POP	%	POP	%	POP.	%	POP
AURORA CENTRAL												
AURORA	40	2,627	75	1,990	40	3,880	80	3,104	40	3,360	90	4,824
MANTUA TWP.	15	180	0	0	20	320	10	32	25	550	50	275
BAINBRIDGE TWP.	20	1,408	0	0	20	2,000	0	0	20	2,900	50	1,450
		4,215		1,990		6,200		3,136		8,810		6,549
MCFARLAND CREEK												
SOUTH RUSSELL	93	7,485	30	745	93	4,185	50	2,093	93	6,320	100	6,320
RUSSELL	2	93	50	46	2	154	100	124	2	186	100	186
BAINBRIDGE	60	4,220	20	844	60	6,000	50	3,000	60	8,700	100	8,700
		6,798		1,635		10,319		5,217		15,206		15,206
SOLON NORTHEAST												
SOLON	23	2,700	50	1,350	27	4,200	75	3,150	28	5,600	100	5600
FAIRMOUNT RD												
CHESTER TWP.	38	3,955	10	395	38	5,620	50	2,810	38	7,780	100	7,780
RUSSELL TWP.	50	2,335	10	233	50	3,350	50	1,675	50	4,650	100	4,650
		6,290		628		8,970		4,485		12,430		12,430
CHAGRIN FALLS												
CHAGRIN FALLS	100	4,848	95	4,606	100	6,200	100	6,200	100	7,400	100	7,400
CHAGRIN FALLS TWP.	100	84	0	0	100	170	50	85	100	250	100	250
RUSSELL TWP.	10	470	0	0	10	670	50	335	10	930	100	930
MORELAND HILLS	10	200	0	0	10	390	0	0	10	450	75	337
BENTLEYVILLE	100	338	0	0	100	400	0	0	100	400	75	300
BAINBRIDGE TWP.	2	140	0	0	2	200	50	100	2	290	100	290
		6,180		4,606		8,030		6,720		9,720		9,507

ER WATERSHED

TOTAL AREA WITHIN S.D	POP WITHIN S.D. 1990 BASED ON	POP WITHIN S.D. 1990 SERVED BY SEWERS FROM S.D		TOTAL AREA WITHIN S.D	POP WITHIN S.D. 2000 BASED ON	POP WITHIN S.D. 2000 SERVED BY SEWERS FROM S.D		TOTAL AREA WITHIN S.D	POP WITHIN S.D. 2010 BASED ON	POP WITHIN S.D. 2010 SERVED BY SEWERS FROM S.D		TOTAL AREA WITHIN S.D	POP WITHIN S.D. 2020 BASED ON	POP WITHIN S.D. 2020 SERVED BY SEWERS FROM S.D	
%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.	%	POP.
40	3,360	90	4,824	40	6,880	100	6,880	40	8,160	100	8,160	40	9,000	100	9,000
25	550	50	275	30	840	100	840	55	1,120	100	1,120	55	1,925	100	1,925
20	2,400	60	1,450	20	3,880	100	3,880	20	4,740	100	4,740	20	5,360	100	5,360
	8,810		6,549		11,600		11,600		14,020		14,020		16,285		16,285
93	6,320	100	6,320	93	8,550	100	8,550	93	10,600	100	10,600	93	12,200	100	12,200
2	186	100	186	2	246	100	246	2	300	100	300	1	340	100	340
60	8,700	100	8,700	60	11,630	100	11,630	60	14,220	100	14,220	60	16,090	100	16,090
	15,206		15,206		20,426		20,426		25,120		25,120		28,630		28,630
29	5,600	100	5600	31	6,400	100	6,400	36	8,600	100	8,600	42	10,000	100	10,000
38	7,780	100	7,780	38	10,300	100	10,300	38	12,530	100	12,530	38	14,180	100	14,180
50	4,650	100	4,650	50	6,150	100	6,150	50	7,500	100	7,500	50	8,500	100	8,500
	12,430		12,430		16,450		16,450		20,030		20,030		22,680		22,680
100	7,400	100	7,400	100	8,300	100	8,300	100	8,800	100	8,800	100	8,900	100	8,900
100	250	100	250	100	320	100	320	100	400	100	400	100	500	100	500
10	930	100	930	10	1,230	100	1,230	10	1,500	100	1,500	10	1,700	100	1,700
10	450	75	337	10	500	100	500	10	530	100	530	10	530	100	530
100	400	75	300	100	500	100	500	100	500	100	500	100	500	100	500
2	290	100	290	2	388	100	388	2	474	100	474	2	536	100	536
	9,720		9,507		11,238		11,238		12,204		12,204		12,666		12,666

TABLE A-5-2

AREAS OUTSIDE OF SEWERAGE DISTRICTS
IN 1980 THAT ARE SERVED BY INDIVIDUAL SYSTEMS

Area	1970 %	1970 Population	1980 %	1980 Population	1990 %	1990 Population	2000 %	2000 Popula
Grafton	10	126	10	140	10	140	10	
Hinckley Township	55	2,317	55	2,920	55	4,020	55	5,0
Granger Township	40	856	40	1,080	40	1,480	40	1,8
Sharon Township	10	276	10	350	10	480	10	
Bath Township	96	7,250	96	9,025	96	10,655	96	12,0
Brecksville	10	914	10	1,420	10	1,820	10	2,0
Northfield Center Township	25	988	25	1,750	25	2,750	25	3,2
Boston Township	100	1,504	100	1,900	100	2,200	100	2,5
Boston Heights	10	85	10	100	10	110	10	
Peninsula	100	692	100	800	100	900	100	1,0
Northampton Township	40	2,265	40	2,840	40	3,360	40	3,7
Hudson	7	312	7	455	7	512	7	
Stow	4	792	4	1,067	4	1,304	4	1,4
Tallmadge	8	1,221	8	1,583	8	1,912	8	2,1
Akron	1	2,754	1	2,932	1	3,212	1	3,4
Lakemore Village	70	1,895	70	2,100	70	2,310	70	2,5
Springfield Township	18	3,045	18	3,820	18	4,500	18	5,0
Glenwillow	100	526	100	600	100	700	100	
Moreland Hills	70	2,100	70	2,730	70	3,150	70	3,5
Hunting Valley	40	269	40	480	40	800	40	
Gates Mills	40	950	40	1,200	40	1,480	40	1,8
Mayfield	47	1,670	47	2,258	47	2,774	47	3,4
Willoughby Hills Township	60	3,143	60	4,200	60	5,640	60	7,0
Waite Hill	100	514	100	700	100	1,000	100	1,3
Streetsboro	7	558	7	700	7	917	7	1,2
Franklin Township	39	2,277	39	3,120	39	4,170	39	5,4
Burton Township	83	1,966	83	2,820	83	3,984	83	5,4
Middlefield Township	17	465	17	664	17	935	17	1,2
Bainbridge Township	15	1,054	15	1,500	15	2,178	15	2,8
Suffield Township	90	5,219	90	7,110	90	9,540	90	12,3

TABLE A-5-2

UTSIDE OF SEWERAGE DISTRICTS
T ARE SERVED BY INDIVIDUAL SYSTEMS

1990		2000		2010		2020	
%	Population	%	Population	%	Population	%	Population
10	140	10	150	10	150	10	150
55	4,020	55	5,055	55	5,995	55	6,600
40	1,480	40	1,880	40	2,200	40	2,440
10	480	10	600	10	710	10	780
96	10,655	96	12,000	96	12,680	96	12,880
10	1,820	10	2,030	10	2,210	10	2,260
25	2,750	25	3,250	25	3,750	25	4,250
100	2,200	100	2,500	100	2,600	100	2,700
10	110	10	120	10	130	10	130
100	900	100	1,000	100	1,000	100	1,000
40	3,360	40	3,760	40	4,000	40	4,040
7	512	7	546	7	602	7	638
4	1,304	4	1,482	4	1,582	4	1,617
8	1,912	8	2,160	8	2,303	8	2,338
1	3,212	1	3,470	1	3,611	1	3,628
70	2,310	70	2,510	70	2,660	70	2,660
18	4,500	18	5,045	18	5,330	18	5,380
100	700	100	700	100	700	100	700
70	3,150	70	3,500	70	3,710	70	3,710
40	800	40	960	40	1,120	40	1,280
40	1,480	40	1,640	40	1,760	40	1,760
47	2,774	47	3,147	47	3,384	47	3,384
60	5,640	60	7,020	60	8,285	60	9,056
100	1,000	100	1,200	100	1,400	100	1,500
7	917	7	1,155	7	1,351	7	1,484
39	4,170	39	5,260	39	6,160	39	6,710
83	3,984	83	5,150	83	6,310	83	7,140
17	935	17	1,223	17	1,497	17	1,683
15	2,178	15	2,910	15	3,558	15	4,020
90	9,540	90	12,070	90	14,050	90	15,400

TABLE A-6-3 (Cont'd.)

AREAS OUTSIDE OF SEWERAGE DISTRICTS
IN 1980 THAT ARE SERVED BY INDIVIDUAL SYSTEMS

Area	1970 %	1970 Population	1980 %	1980 Population	1990 %	1990 Population	2000 %	2000 Population
Randolph Township	60	2,490	60	3,420	60	4,556	60	5,756
Marlboro Township		75		75		100		125
Lake Township		100		100		125		150
Hartville		50		50		75		100
Hiram Township	10	140	10	190	10	260	10	320
Newbury Township	100	4,038	100	5,700	100	8,000	100	10,600
Kirtland	100	5,530	100	7,200	100	9,500	100	11,700
Kirtland Hills	25	113	25	150	25	200	25	250
Chardon Township	60	1,910	60	2,700	60	3,780	60	4,980
Hambden Township	34	850	34	1,190	34	1,668	34	2,210
Montville Township	15	196	15	285	15	390	15	510
Chester Township	62	6,450	62	9,170	62	12,700	62	16,800
Russell Township	38	1,775	38	2,545	38	3,538	38	4,675
South Russell	7	187	7	315	7	476	7	645
Auburn Township	100	1,517	100	2,300	100	3,200	100	4,200
Troy Township	85	1,404	85	2,000	85	2,800	85	3,700
Clairidon Township	100	2,124	100	3,000	100	4,200	100	5,800
Munson Township	100	3,569	100	5,100	100	7,100	100	9,400
Huntsburg Township	32	574	32	832	32	1,152	32	1,504
GRAND TOTAL		81,095		108,686		142,753		176,918

TABLE A-6-3 (Cont'd.)

IDE OF SEWERAGE DISTRICTS
E SERVED BY INDIVIDUAL SYSTEMS

%	1990 Population	%	2000 Population	%	2010 Population	%	2020 Population
60	4,556	60	5,756	60	6,720	60	7,320
	100		125		150		175
	125		150		175		200
	75		100		125		150
10	260	10	320	10	380	10	410
00	8,000	100	10,600	100	12,900	100	14,600
00	9,500	100	11,700	100	13,700	100	15,000
25	200	25	250	25	300	25	325
60	3,780	60	4,980	60	6,120	60	6,900
34	1,668	34	2,210	34	3,720	34	3,060
15	390	15	510	15	630	15	705
62	12,700	62	16,800	62	20,450	62	23,140
38	3,538	38	4,675	38	5,700	38	6,460
7	476	7	645	7	798	7	917
00	3,200	100	4,200	100	5,100	100	5,800
85	2,800	85	3,700	85	4,500	85	5,000
00	4,200	100	5,800	100	6,800	100	7,700
00	7,100	100	9,400	100	11,500	100	12,900
32	1,152	32	1,504	32	1,857	32	2,080
	142,753		176,918		206,423		224,160

6. Wastewater Flows and Loads (Present and Future) - The development of reasonably accurate projected wastewater flows and loads is essential for the planning of future wastewater management programs, especially in consideration of municipal wastes, which account for the majority of wastewater flows.

The present per capita flow of municipal wastewater for separate and combined systems are found to be 110 to 156 gpcd, respectively, for the study area. These figures are based upon 1970 population data and on 1970 wastewater treatment plant records. Industrial flows have been deducted from the total plant flow in computing these figures, and are not included.

In projecting the future municipal waste flows, consideration was given to such factors as:

1. The present trend of increase in water consumption, per capita.
2. The increased use of water saving devices for the home.
3. The possible development of water reuse systems for the home.
4. Reduction in infiltration rates due to improved sewer construction techniques.
5. Replacement of certain existing combined sewers with separate sewers.

Present trends in water consumption for the study area show an increase in water consumption in the range of 1.0 to 1.3 gpcd per year. This per capita increase is due in part to the increased use of various modern facilities such as the automatic clothes washer, the automatic dishwasher, and garbage grinder, which use more water than previous methods. This trend is also due to the fact that there is an "abundance" of water in the study area. In this area the population in general does not feel a water supply shortage, and therefore does not generally make an attempt to conserve water.

Approximately 70% of total household water usage is for toilet flushing and bathing. (1) Flow reduction devices have been developed for these two

(1) E.R. McLaughlin, "A Recycle System for Conservation of Water in Residences", Water and Sewage Works, April, 1968.

critical areas. Present toilets use 4 to 6 gallons per flush.[2] The newly developed reduced flush toilets use 2-1/2 gallons per flush. These are already in use in some foreign countries where water shortages exist. Dual flush toilets have also been developed, which use even smaller quantities of water when only urine is to be disposed of.

Present shower heads discharge between 5 and 10 gallons per minute. This flow can be reduced and still be acceptable. The reduced flush toilet and the limited flow shower head might provide a 30-50% reduction in domestic water usage. They are also economically feasible in that the capital costs are low and the yearly water savings and waste flow reduction is substantial.

The following household water reuse methods have been investigated:[2]

1. Reuse of all wastewaters, except for drinking.
2. Reuse of nonsanitary water for toilet water and laundering.
3. Aerobic treatment and reuse of all wastewaters for lawn watering.
4. Reuse of wash water for toilet flushing.

The only one of these which appears reasonably feasible in this area is the reuse of washwater for toilet flushing. It is doubtful however, that reuse technique will be developed to any significant extent in the study area. This is due to the relative abundance of water to handle future demands. In other areas of the country, where water shortages and water pollution from municipal wastes is a critical problem, these techniques will be more likely to be developed.

The resulting municipal wastewater flow projections are shown in Table A-6-1.

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[2] J. Bailey and H. Wallman, "Flow Reduction of Wastewater from Households", Water and Sewage Works, March, 1971.

TABLE A-6-1

MUNICIPAL WASTEWATER FLOWS

(gpcd - gallons per capita per day)

	1970	1980	1990	2000	2010	2020
Separate systems	110	120	125	130	140	150
Combined systems	156	160	164	168	172	175

The present and projected pollution loads from municipal wastewater treatment plants have also been estimated. The per capita generation rates for nitrogen and phosphorus were based upon monthly data from the Cleveland Easterly, Southerly, and Westerly Wastewater Treatment Plants.[3] Table A-6-2 shows the projected municipal wastewater pollution loads for the study area in pounds per capita per day.

TABLE A-6-2

MUNICIPAL WASTEWATER POLLUTION LOADS

(pounds per capita per day)

	1970	1980	1990	2000	2010	2020
BOD						
Separate System	.17	.18	.185	.19	.19	.195
Combined System	.15	.15	.16	.16	.17	.17
Suspended Solids						
Separate System	.18	.185	.19	.195	.195	.20
Combined System	.23	.23	.24	.24	.25	.25
Organic Nitrogen	.0146	.0146	.0146	.0146	.0146	.0146
Ammonia Nitrogen	.0097	.0097	.0097	.0097	.0097	.0097
Total Phosphorus as P	.0116	.0116	.0116	.0116	.0116	.0116
Sulfate	.0367	.0367	.0367	.0367	.0367	.0367
Chloride	.046	.046	.046	.046	.046	.046

[3] H & E, Ltd., "Feasibility Study for Wastewater Management Program", for Department of the Army, July, 1971.

A computer program was written to calculate and tabulate the present and future municipal wastewater flows and pollution loads based on the data in Tables A-6-1 and A-6-2. The program was run for each of the sewerage districts in the study area, based upon the population projections. This information is given in Table A-6-3. The total municipal wastewater flows and pollution loads for the Cuyahoga, Rocky and Chagrin River watersheds and for the direct discharges into Lake Erie are shown in Table A-6-4.

These tables do not include industrial flows or loads. The industrial loads were computed by AWARE and are presented in this phase report.

TABLE A-6-3

FLOWS AND LOADS IN INDIVIDUAL SEWERAGE DISTRICTS

LAKE ERIE

ROCKY RIVER	1970	1980	1990	2000	2010	2020
POPULATION	61537.	89340.	111900.	125805.	137700.	143430.
FLOW (MGD)	6.77	10.72	13.99	16.35	19.28	21.59
BOD (LBS/YR)	3818370.	5809637.	7556047.	8724576.	9543493.	10244220.
SUSPENDED SOLIDS (LBS/YR)	4042580.	6032682.	7760263.	9054170.	9886736.	10506030.
ORGANIC NITROGEN (LBS/YR)	327931.	476093.	596315.	670415.	733803.	767003.
AMMONIA NITROGEN (LBS/YR)	217872.	316309.	396182.	446412.	487527.	509584.
TOTAL PHOSPHORUS AS P (LBS/YR)	260548.	378265.	473784.	532658.	583022.	609339.
SULFATE (LBS/YR)	824310.	1196753.	1498955.	1685220.	1844560.	1928014.
CHLORIDE (LBS/YR)	1033206.	1500017.	1878830.	2112264.	2311982.	2416583.
NEW SEPARATE SEWER AREA						

WESTERLY	1970	1980	1990	2000	2010	2020
POPULATION	160000.	151000.	151000.	152000.	153000.	160000.
FLOW (MGD)	24.96	24.16	24.76	25.54	26.32	28.00
BOD (LBS/YR)	8759938.	8267248.	8813401.	8876801.	9493650.	9928000.
SUSPENDED SOLIDS (LBS/YR)	13432000.	12676450.	13227600.	13315200.	13961250.	14600000.
ORGANIC NITROGEN (LBS/YR)	852640.	804679.	804679.	810008.	815337.	852640.
AMMONIA NITROGEN (LBS/YR)	566480.	534615.	534615.	538156.	541696.	566480.
TOTAL PHOSPHORUS AS P (LBS/YR)	677440.	639334.	639334.	643568.	647802.	677440.
SULFATE (LBS/YR)	2143278.	2022720.	2022720.	2036115.	2049510.	2143278.
CHLORIDE (LBS/YR)	2686400.	2535290.	2535290.	2552080.	2568870.	2686400.
COMBINED SEWER AREA						

EASTERLY	1970	1980	1990	2000	2010	2020
POPULATION	454765.	501812.	576810.	630533.	659683.	697073.
FLOW (MGD)	70.94	80.29	94.60	105.73	113.47	115.08
BOD (LBS/YR)	24808350.	27474190.	33090050.	36823100.	40933630.	40802380.
SUSPENDED SOLIDS (LBS/YR)	38177500.	42127100.	50529060.	55234670.	60106530.	60003540.
ORGANIC NITROGEN (LBS/YR)	2423441.	2674159.	3073851.	3360110.	3515477.	3504206.
AMMONIA NITROGEN (LBS/YR)	1610094.	1776664.	2042216.	2232401.	2335625.	2328136.
TOTAL PHOSPHORUS AS P (LBS/YR)	1925474.	2124670.	2442237.	2669675.	2793115.	2784162.
SULFATE (LBS/YR)	6091804.	6722021.	7726737.	8446303.	8836849.	8808517.
CHLORIDE (LBS/YR)	7635503.	8425423.	9684740.	10586650.	11076160.	11040650.
COMBINED SEWER AREA						

TABLE A-6-3 (Cont'd.)

LAKE ERIE

EUCLID	1970	1980	1990	2000	2010	2020
POPULATION	119110.	142018.	179430.	204550.	226617.	237030.
FLOW (MGD)	12.66	17.11	21.93	26.59	31.73	35.55
BOD (LBS/YR)	7142579.	9370001.	11846520.	14185540.	16715890.	16870610.
SUSPENDED SOLIDS (LBS/YR)	7962727.	9630279.	12166690.	14558840.	14129460.	17303180.
ORGANIC NITROGEN (LBS/YR)	613421.	760811.	934914.	1090847.	1287642.	1263132.
AMMONIA NITROGEN (LBS/YR)	407547.	504939.	621142.	724209.	802337.	839205.
TOTAL PHOSPHORUS AS P (LBS/YR)	487376.	603844.	742809.	866064.	959496.	1003585.
SULFATE (LBS/YR)	1541955.	1918438.	2350092.	2740049.	3035646.	3175135.
CHLORIDE (LBS/YR)	1932696.	2394555.	2945619.	3434393.	3804898.	3979733.
NEW SEPARATE SEWER AREA						

WILLOUGHBY-EASTLAKE	1970	1980	1990	2000	2010	2020
POPULATION	38324.	52100.	76900.	97300.	115200.	126800.
FLOW (MGD)	4.22	6.25	9.61	12.65	16.13	19.02
BOD (LBS/YR)	2378003.	3422970.	5192672.	6747753.	7989118.	9024988.
SUSPENDED SOLIDS (LBS/YR)	2517835.	3518052.	5333013.	6925326.	8199358.	9256398.
ORGANIC NITROGEN (LBS/YR)	204228.	277641.	409800.	518512.	613901.	675717.
AMMONIA NITROGEN (LBS/YR)	135686.	184460.	272264.	344491.	407866.	448935.
TOTAL PHOSPHORUS AS P (LBS/YR)	162264.	220591.	325594.	411968.	487757.	536871.
SULFATE (LBS/YR)	513369.	697905.	1030114.	1303382.	1543161.	1698548.
CHLORIDE (LBS/YR)	643460.	874753.	1291150.	1633665.	1934207.	2128970.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

ROCKY RIVER WATERSHED

MEDINA CO. S D 400	1970	1980	1990	2000	2010	2020
POPULATION	20883.	47783.	66143.	83212.	100983.	120903.
FLOW (MGD)	2.30	5.73	8.27	10.82	14.14	18.08
BOD (LBS/YR)	1296100.	3139342.	4466305.	5770751.	7003170.	8577156.
SUSPENDED SOLIDS (LBS/YR)	1372341.	3226545.	4587016.	5922612.	7187464.	8797083.
ORGANIC NITROGEN (LBS/YR)	111312.	264836.	382470.	443437.	538138.	642137.
AMMONIA NITROGEN (LBS/YR)	73354.	169176.	234179.	294612.	357530.	426658.
TOTAL PHOSPHORUS AS P (LBS/YR)	83440.	202313.	280048.	352319.	427562.	510231.
SULFATE (LBS/YR)	270805.	640077.	880018.	1114666.	1352717.	1614263.
CHLORIDE (LBS/YR)	350709.	802276.	1110540.	1397129.	1695503.	2023329.
NEW SEPARATE SEWER AREA						

MEDINA COUNTY S D	1970	1980	1990	2000	2010	2020
POPULATION	1825.	7616.	13789.	15812.	17585.	18840.
FLOW (MGD)	0.20	0.91	1.72	2.06	2.46	2.83
BOD (LBS/YR)	113241.	500371.	930832.	1096562.	1210519.	1340936.
SUSPENDED SOLIDS (LBS/YR)	119902.	514270.	955990.	1125419.	1251612.	1375319.
ORGANIC NITROGEN (LBS/YR)	9725.	40586.	73460.	84262.	93710.	100398.
AMMONIA NITROGEN (LBS/YR)	6461.	26064.	48806.	55982.	62260.	66703.
TOTAL PHOSPHORUS AS P (LBS/YR)	7727.	32246.	58366.	66948.	74455.	79768.
SULFATE (LBS/YR)	24447.	102020.	184657.	211810.	235560.	252371.
CHLORIDE (LBS/YR)	30642.	127873.	231450.	265483.	295252.	316323.
NEW SEPARATE SEWER AREA						

NO. ROYALTON A	1970	1980	1990	2000	2010	2020
POPULATION	2484.	5075.	8635.	9760.	10350.	10350.
FLOW (MGD)	0.27	0.61	1.09	1.27	1.45	1.55
BOD (LBS/YR)	154132.	333427.	580405.	676896.	717772.	736661.
SUSPENDED SOLIDS (LBS/YR)	163199.	342639.	602305.	694668.	736681.	755550.
ORGANIC NITROGEN (LBS/YR)	13237.	27045.	46282.	52011.	55155.	55155.
AMMONIA NITROGEN (LBS/YR)	8795.	17968.	30749.	34555.	36644.	36644.
TOTAL PHOSPHORUS AS P (LBS/YR)	10517.	21488.	36772.	41324.	43822.	43822.
SULFATE (LBS/YR)	33274.	67982.	116340.	130740.	138643.	138643.
CHLORIDE (LBS/YR)	41706.	86209.	145821.	163870.	173776.	173776.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

ROCKY RIVER WATERSHED

STRONGSVILLE B	1970	1980	1990	2000	2010	2020
POPULATION	1500.	3465.	4300.	4890.	5200.	5240.
FLOW (MGD)	0.16	0.42	0.54	0.63	0.73	0.79
BOD (LBS/YR)	93075.	227650.	290357.	338428.	360620.	372957.
SUSPENDED SOLIDS (LBS/YR)	98550.	233074.	293205.	347334.	370110.	382920.
ORGANIC NITROGEN (LBS/YR)	7993.	18465.	22915.	26006.	27711.	27924.
AMMONIA NITROGEN (LBS/YR)	5311.	12268.	15224.	17278.	18411.	18552.
TOTAL PHOSPHORUS AS P (LBS/YR)	6351.	14671.	18206.	20662.	22017.	22186.
SULFATE (LBS/YR)	20033.	46415.	57601.	65370.	69657.	70192.
CHLORIDE (LBS/YR)	25185.	58177.	72137.	81935.	87308.	87980.
NEW SEPARATE SEWER AREA						

NO ROYALTON B	1970	1980	1990	2000	2010	2020
POPULATION	2948.	3708.	4449.	4991.	5290.	5290.
FLOW (MGD)	0.32	0.44	0.56	0.65	0.74	0.79
BOD (LBS/YR)	182923.	243353.	300419.	346126.	366861.	376516.
SUSPENDED SOLIDS (LBS/YR)	193683.	250113.	303538.	355234.	376516.	386170.
ORGANIC NITROGEN (LBS/YR)	15710.	19739.	23709.	26597.	28190.	28190.
AMMONIA NITROGEN (LBS/YR)	10437.	13114.	15752.	17671.	18729.	18729.
TOTAL PHOSPHORUS AS P (LBS/YR)	12482.	15683.	13837.	21132.	22398.	22398.
SULFATE (LBS/YR)	39390.	49617.	59597.	66857.	70862.	70862.
CHLORIDE (LBS/YR)	49497.	62130.	74699.	83799.	88819.	88819.
NEW SEPARATE SEWER AREA						

STRONGSVILLE C	1970	1980	1990	2000	2010	2020
POPULATION	1200.	3060.	3739.	4305.	4595.	4620.
FLOW (MGD)	0.13	0.37	0.47	0.56	0.64	0.69
BOD (LBS/YR)	74460.	201042.	256527.	298552.	318663.	328828.
SUSPENDED SOLIDS (LBS/YR)	78840.	206626.	263461.	306408.	327049.	337260.
ORGANIC NITROGEN (LBS/YR)	6395.	16307.	20245.	22941.	24487.	24620.
AMMONIA NITROGEN (LBS/YR)	4249.	10834.	13450.	15242.	16269.	16357.
TOTAL PHOSPHORUS AS P (LBS/YR)	5081.	12956.	16085.	18227.	19455.	19561.
SULFATE (LBS/YR)	16025.	40390.	50889.	57668.	61552.	61887.
CHLORIDE (LBS/YR)	20148.	51377.	63785.	72281.	77150.	77570.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

ROCKY RIVER WATERSHED

BEREA	1970	1980	1990	2000	2010	2020
POPULATION	22306.	27600.	33000.	36900.	39100.	39100.
FLOW (MGD)	2.86	3.31	4.12	4.80	5.47	5.86
BOD (LBS/YR)	1389671.	1313320.	2228329.	2559013.	2711583.	2782941.
SUSPENDED SOLIDS (LBS/YR)	1471417.	1363630.	2288548.	2626356.	2782941.	2854298.
ORGANIC NITROGEN (LBS/YR)	119348.	147080.	175857.	136640.	208364.	208364.
AMMONIA NITROGEN (LBS/YR)	79293.	97718.	116836.	130644.	138433.	138433.
TOTAL PHOSPHORUS AS P (LBS/YR)	94825.	116858.	139722.	156234.	165549.	165549.
SULFATE (LBS/YR)	300006.	369716.	442051.	494294.	523764.	523764.
CHLORIDE (LBS/YR)	376029.	463404.	554070.	619551.	656489.	656489.
NEW SEPARATE SEWER AREA						

NO. OLMSTED	1970	1980	1990	2000	2010	2020
POPULATION	45361.	70666.	91390.	107060.	114498.	115793.
FLOW (MGD)	4.99	8.49	11.42	13.92	16.03	17.37
BOD (LBS/YR)	2814649.	4642755.	6171109.	7424610.	7940835.	8241565.
SUSPENDED SOLIDS (LBS/YR)	2980216.	4771720.	6337895.	7619995.	8149393.	8452898.
ORGANIC NITROGEN (LBS/YR)	241729.	376579.	487017.	570523.	610160.	617061.
AMMONIA NITROGEN (LBS/YR)	160601.	250133.	323566.	379046.	405380.	409965.
TOTAL PHOSPHORUS AS P (LBS/YR)	192058.	299200.	386945.	453292.	484784.	490267.
SULFATE (LBS/YR)	607633.	946606.	1224214.	1434122.	1533757.	1551104.
CHLORIDE (LBS/YR)	761611.	1186492.	1534437.	1797536.	1922420.	1944163.
NEW SEPARATE SEWER AREA						

MIDDLEBURG HTS.	1970	1980	1990	2000	2010	2020
POPULATION	12367.	16500.	20300.	23000.	24500.	24600.
FLOW (MGD)	1.36	1.98	2.54	2.99	3.43	3.69
BOD (LBS/YR)	767372.	1084050.	1370757.	1595048.	1699073.	1750903.
SUSPENDED SOLIDS (LBS/YR)	812512.	1114162.	1407804.	1637023.	1743786.	1795798.
ORGANIC NITROGEN (LBS/YR)	65904.	87928.	108179.	122567.	130560.	131093.
AMMONIA NITROGEN (LBS/YR)	43785.	58418.	71872.	81431.	86742.	87096.
TOTAL PHOSPHORUS AS P (LBS/YR)	52362.	69861.	85950.	97382.	103733.	104156.
SULFATE (LBS/YR)	165662.	221026.	271929.	308096.	328190.	329529.
CHLORIDE (LBS/YR)	207642.	277035.	340837.	386170.	411355.	413034.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

ROCKY RIVER WATERSHED

BROOKPARK	1970	1980	1990	2000	2010	2020
POPULATION	16400.	23700.	29800.	33200.	36500.	36800.
FLOW (MGD)	1.80	2.84	3.72	5.62	5.11	5.52
BOD (LBS/YR)	1017620.	1557030.	2012245.	2995318.	2531273.	2619238.
SUSPENDED SOLIDS (LBS/YR)	1077880.	1600342.	2066628.	3074758.	2597886.	2686398.
ORGANIC NITROGEN (LBS/YR)	87396.	126297.	158804.	230213.	194508.	196107.
AMMONIA NITROGEN (LBS/YR)	58064.	83910.	105507.	152949.	129228.	130290.
TOTAL PHOSPHORUS AS P (LBS/YR)	69438.	100346.	126173.	182909.	154541.	155811.
SULFATE (LBS/YR)	219686.	317473.	399136.	578686.	488936.	492954.
CHLORIDE (LBS/YR)	275356.	397923.	500342.	725328.	612835.	617872.
NEW SEPARATE SEWER AREA						

LAKEWOOD	1970	1980	1990	2000	2010	2020
POPULATION	80632.	91860.	105404.	116240.	123082.	124784.
FLOW (MGD)	8.87	11.02	13.18	15.11	17.23	18.72
BOD (LBS/YR)	5003214.	6035200.	7121456.	8061243.	8535736.	8881500.
SUSPENDED SOLIDS (LBS/YR)	5297521.	6202845.	7313927.	8273380.	8760360.	9109230.
ORGANIC NITROGEN (LBS/YR)	429688.	489522.	562018.	619443.	655904.	664974.
AMMONIA NITROGEN (LBS/YR)	285478.	325230.	373395.	411548.	435772.	441798.
TOTAL PHOSPHORUS AS P (LBS/YR)	341396.	388335.	446534.	492160.	521129.	528335.
SULFATE (LBS/YR)	1080105.	1230510.	1412742.	1557092.	1648743.	1671543.
CHLORIDE (LBS/YR)	1353811.	1542328.	1770740.	1951669.	2066545.	2095122.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

CHAGRIN RIVER WATERSHED

FAIRMOUNT RD	1970	1980	1990	2000	2010	2020
POPULATION	628.	4485.	12430.	16450.	20030.	22680.
FLOW (MGD)	0.07	0.58	1.55	2.14	2.80	3.40
BOD (LBS/YR)	38967.	294664.	839336.	1140867.	1389080.	1614248.
SUSPENDED SOLIDS (LBS/YR)	41260.	302850.	862020.	1170828.	1425635.	1655638.
ORGANIC NITROGEN (LBS/YR)	3347.	23901.	66239.	87662.	106740.	120862.
AMMONIA NITROGEN (LBS/YR)	2223.	15879.	44008.	58241.	70916.	80298.
TOTAL PHOSPHORUS AS P (LBS/YR)	2659.	18989.	52629.	69649.	84807.	96027.
SULFATE (LBS/YR)	8412.	60079.	166506.	220356.	268312.	303810.
CHLORIDE (LBS/YR)	10544.	75303.	208700.	276135.	336304.	380797.
NEW SEPARATE SEWER AREA						

CHAGRIN FALLS	1970	1980	1990	2000	2010	2020
POPULATION	4606.	6720.	9507.	11238.	12204.	12666.
FLOW (MGD)	0.51	0.81	1.19	1.46	1.71	1.90
BOD (LBS/YR)	285802.	441504.	641960.	779355.	848347.	901502.
SUSPENDED SOLIDS (LBS/YR)	302618.	453768.	659310.	799865.	868620.	924618.
ORGANIC NITROGEN (LBS/YR)	24545.	35811.	50663.	59887.	65035.	67497.
AMMONIA NITROGEN (LBS/YR)	16308.	23782.	33660.	39788.	43208.	44844.
TOTAL PHOSPHORUS AS P (LBS/YR)	19502.	28452.	40253.	47582.	51672.	53628.
SULFATE (LBS/YR)	61700.	90018.	127351.	150539.	163479.	169667.
CHLORIDE (LBS/YR)	77335.	112829.	159622.	188686.	204905.	212662.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

CHAGRIN RIVER WATERSHED

AURORA CENTRAL	1970	1980	1990	2000	2010	2020
POPULATION	1990.	3136.	6589.	11600.	14020.	16285.
FLOW (MGD)	0.22	0.38	0.82	1.51	1.96	2.48
BOD (LBS/YR)	123479.	206035.	442221.	804460.	972287.	1159084.
SUSPENDED SOLIDS (LBS/YR)	130743.	211758.	454173.	825630.	997873.	1188804.
ORGANIC NITROGEN (LBS/YR)	10605.	16712.	34300.	61816.	74713.	86783.
AMMONIA NITROGEN (LBS/YR)	7046.	11103.	23187.	41070.	49638.	57657.
TOTAL PHOSPHORUS AS P (LBS/YR)	8426.	13278.	27728.	49114.	59361.	68951.
SULFATE (LBS/YR)	26657.	42008.	87727.	155388.	187805.	218146.
CHLORIDE (LBS/YR)	33412.	52653.	109958.	194764.	235336.	273425.
NEW SEPARATE SEWER AREA						

MCFARLAND CREEK	1970	1980	1990	2000	2010	2020
POPULATION	1635.	5227.	15206.	20426.	25120.	28630.
FLOW (MGD)	0.18	0.63	1.90	2.66	3.52	4.29
BOD (LBS/YR)	101452.	343414.	1026785.	1416543.	1742070.	2037739.
SUSPENDED SOLIDS (LBS/YR)	107419.	352953.	1054536.	1453920.	1787715.	2089988.
ORGANIC NITROGEN (LBS/YR)	8713.	27855.	81033.	108850.	133864.	152569.
AMMONIA NITROGEN (LBS/YR)	5789.	18506.	53837.	72318.	88937.	101364.
TOTAL PHOSPHORUS AS P (LBS/YR)	6923.	22131.	64382.	86484.	106358.	121219.
SULFATE (LBS/YR)	21902.	70018.	203692.	273616.	336495.	383513.
CHLORIDE (LBS/YR)	27452.	87761.	255309.	342952.	421765.	480698.
NEW SEPARATE SEWER AREA						

SOLON NORTHEAST	1970	1980	1990	2000	2010	2020
POPULATION	1350.	3150.	5600.	6900.	8600.	10000.
FLOW (MGD)	0.15	0.38	0.70	0.90	1.20	1.50
BOD (LBS/YR)	83767.	206355.	378140.	478515.	596410.	711750.
SUSPENDED SOLIDS (LBS/YR)	88695.	212704.	388360.	491107.	612105.	730000.
ORGANIC NITROGEN (LBS/YR)	7194.	16786.	29842.	36770.	45829.	53290.
AMMONIA NITROGEN (LBS/YR)	4780.	11153.	19827.	24429.	30448.	35405.
TOTAL PHOSPHORUS AS P (LBS/YR)	5716.	13337.	23710.	29215.	36412.	42340.
SULFATE (LBS/YR)	18084.	42196.	75015.	92429.	115201.	133955.
CHLORIDE (LBS/YR)	22666.	52888.	94024.	115851.	144394.	167900.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

CUYAHOGA RIVER WATERSHED

MIDDLEFIELD	1970	1980	1990	2000	2010	2020
POPULATION	1700.	3000.	4700.	5200.	7000.	8200.
FLOW (MGD)	0.19	0.36	0.59	0.68	0.98	1.23
BOD (LBS/YR)	109485.	197190.	317367.	360620.	485450.	583635.
SUSPENDED SOLIDS (LBS/YR)	111690.	202575.	325945.	370110.	498225.	598600.
ORGANIC NITROGEN (LBS/YR)	9059.	15987.	25046.	27711.	37303.	43038.
AMMONIA NITROGEN (LBS/YR)	6019.	10621.	16640.	18411.	24783.	29032.
TOTAL PHOSPHORUS AS P (LBS/YR)	7198.	12702.	19900.	22017.	29638.	34719.
SULFATE (LBS/YR)	22772.	40136.	62959.	69657.	93768.	109843.
CHLORIDE (LBS/YR)	28543.	50370.	78913.	87308.	117530.	137678.
NEW SEPARATE SEWER AREA						

BURTON	1970	1980	1990	2000	2010	2020
POPULATION	1100.	2100.	2900.	3500.	4200.	5100.
FLOW (MGD)	0.12	0.25	0.36	0.45	0.59	0.76
BOD (LBS/YR)	68255.	137970.	195822.	242725.	291270.	362992.
SUSPENDED SOLIDS (LBS/YR)	72270.	141802.	201115.	249112.	298935.	372300.
ORGANIC NITROGEN (LBS/YR)	5862.	11191.	15454.	19651.	22382.	27178.
AMMONIA NITROGEN (LBS/YR)	3895.	7435.	10267.	12392.	14870.	18057.
TOTAL PHOSPHORUS AS P (LBS/YR)	4657.	8891.	12279.	14819.	17783.	21593.
SULFATE (LBS/YR)	14735.	28131.	38847.	46884.	56261.	68317.
CHLORIDE (LBS/YR)	18469.	35259.	48691.	58765.	70518.	85629.
NEW SEPARATE SEWER AREA						

MANTUA	1970	1980	1990	2000	2010	2020
POPULATION	1440.	1850.	2330.	2940.	3620.	3975.
FLOW (MGD)	0.16	0.22	0.30	0.38	0.51	0.60
BOD (LBS/YR)	89352.	121545.	160709.	203889.	251047.	282320.
SUSPENDED SOLIDS (LBS/YR)	94608.	128721.	165053.	209254.	257653.	290175.
ORGANIC NITROGEN (LBS/YR)	7674.	9859.	12683.	15667.	19291.	21183.
AMMONIA NITROGEN (LBS/YR)	5098.	6550.	8426.	10409.	12817.	14073.
TOTAL PHOSPHORUS AS P (LBS/YR)	6097.	7833.	10077.	12448.	15327.	16830.
SULFATE (LBS/YR)	19290.	24782.	31881.	39383.	48492.	53247.
CHLORIDE (LBS/YR)	24178.	31061.	39960.	49363.	60780.	66740.
NEW SEPARATE SEWER AREA						

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TABLE A-6-3 (Cont'd.)

CUYAHOGA RIVER WATERSHED

SHALERSVILLE	1970	1980	1990	2000	2010	2020
POPULATION	2982.	4030.	5464.	6900.	8040.	8930.
FLOW (MGD)	0.33	0.49	0.68	0.90	1.13	1.32
BOD (LBS/YR)	185033.	268056.	368956.	478515.	557574.	628475.
SUSPENDED SOLIDS (LBS/YR)	195917.	275502.	378328.	491107.	572247.	644590.
ORGANIC NITROGEN (LBS/YR)	15891.	21742.	29118.	36770.	42845.	47055.
AMMONIA NITROGEN (LBS/YR)	10558.	14445.	19345.	24429.	28466.	31263.
TOTAL PHOSPHORUS AS P (LBS/YR)	12626.	17275.	23135.	29215.	34041.	37386.
SULFATE (LBS/YR)	39945.	54654.	73193.	92429.	107700.	118282.
CHLORIDE (LBS/YR)	50068.	68503.	91740.	115851.	134991.	148256.
NEW SEPARATE SEWER AREA						

TWIN LAKES	1970	1980	1990	2000	2010	2020
POPULATION	0.	1680.	2226.	2805.	3282.	3589.
FLOW (MGD)	0.00	0.20	0.28	0.36	0.46	0.54
BOD (LBS/YR)	0.	110376.	150311.	194527.	227607.	255447.
SUSPENDED SOLIDS (LBS/YR)	0.	113442.	154373.	199646.	233596.	261997.
ORGANIC NITROGEN (LBS/YR)	0.	8053.	11862.	14948.	17490.	19126.
AMMONIA NITROGEN (LBS/YR)	0.	5948.	7881.	9931.	11620.	12707.
TOTAL PHOSPHORUS AS P (LBS/YR)	0.	7113.	9425.	11876.	13896.	15196.
SULFATE (LBS/YR)	0.	22504.	29818.	37574.	43964.	48076.
CHLORIDE (LBS/YR)	0.	28207.	37375.	47096.	55105.	60259.
NEW SEPARATE SEWER AREA						

RAVENNA	1970	1980	1990	2000	2010	2020
POPULATION	13485.	22324.	37160.	58650.	68220.	74315.
FLOW (MGD)	1.48	2.68	4.64	7.62	9.55	11.15
BOD (LBS/YR)	834262.	1486686.	2509228.	4067376.	4731055.	5289368.
SUSPENDED SOLIDS (LBS/YR)	883336.	1507427.	2577045.	4174412.	4855557.	5424993.
ORGANIC NITROGEN (LBS/YR)	71648.	118965.	198026.	312546.	363544.	396025.
AMMONIA NITROGEN (LBS/YR)	47602.	79038.	131569.	207650.	241533.	263112.
TOTAL PHOSPHORUS AS P (LBS/YR)	56926.	94520.	157335.	248324.	288843.	314650.
SULFATE (LBS/YR)	180102.	299041.	497777.	785646.	913841.	995486.
CHLORIDE (LBS/YR)	225741.	374820.	623916.	984733.	1145413.	1247748.
NEW SEPARATE SEWER AREA						

(1) E.R. McLaughlin, "A Recycle System for Conservation of Water in Residences", Water and Sewage Works, April, 1968.

TABLE A-6-3 (Cont'd.)

CUYAHOGA RIVER WATERSHED

KENT	1970	1980	1990	2000	2010	2020
POPULATION	25365.	40800.	56100.	71300.	85100.	93700.
FLOW (MGD)	2.77	4.90	7.01	9.35	11.91	14.06
BOD (LBS/YR)	1573897.	2680560.	3788152.	4986263.	5901683.	6663096.
SUSPENDED SOLIDS (LBS/YR)	1666480.	2755020.	3830533.	5117431.	6056991.	6840098.
ORGANIC NITROGEN (LBS/YR)	135170.	217423.	298957.	383155.	453498.	499327.
AMMONIA NITROGEN (LBS/YR)	89805.	144452.	198622.	254562.	301296.	331745.
TOTAL PHOSPHORUS AS P (LBS/YR)	107395.	172747.	237527.	304424.	360313.	396726.
SULFATE (LBS/YR)	339777.	546536.	751487.	963136.	1139957.	1255153.
CHLORIDE (LBS/YR)	425878.	635032.	941919.	1207200.	1428828.	1573222.
NEW SEPARATE SEWER AREA						

FISH CREEK	1970	1980	1990	2000	2010	2020
POPULATION	7659.	24041.	42462.	49604.	54690.	56900.
FLOW (MGD)	0.84	2.83	5.31	6.45	7.66	8.53
BOD (LBS/YR)	475241.	1579493.	2867246.	3440036.	3792750.	4049856.
SUSPENDED SOLIDS (LBS/YR)	503196.	1623367.	2944738.	3530563.	3892559.	4153698.
ORGANIC NITROGEN (LBS/YR)	40815.	128114.	226280.	264340.	291443.	303220.
AMMONIA NITROGEN (LBS/YR)	27117.	85117.	150337.	175623.	193630.	201458.
TOTAL PHOSPHORUS AS P (LBS/YR)	32428.	101789.	179784.	210023.	231557.	240914.
SULFATE (LBS/YR)	102596.	322041.	568800.	664470.	732600.	762204.
CHLORIDE (LBS/YR)	128595.	403648.	712937.	832851.	918245.	955351.
NEW SEPARATE SEWER AREA						

HUDSON S D 6	1970	1980	1990	2000	2010	2020
POPULATION	4860.	8340.	11500.	14100.	17600.	20600.
FLOW (MGD)	0.53	1.06	1.44	1.83	2.46	3.09
BOD (LBS/YR)	301563.	530783.	776537.	977835.	1220559.	1466204.
SUSPENDED SOLIDS (LBS/YR)	319302.	536921.	737525.	1003567.	1252679.	1503798.
ORGANIC NITROGEN (LBS/YR)	25899.	47108.	61283.	75133.	93790.	109777.
AMMONIA NITROGEN (LBS/YR)	17207.	31298.	40716.	49921.	62313.	72934.
TOTAL PHOSPHORUS AS P (LBS/YR)	20577.	37429.	48691.	59699.	74518.	87220.
SULFATE (LBS/YR)	65102.	118416.	154048.	188876.	235761.	275947.
CHLORIDE (LBS/YR)	81599.	148423.	193085.	236739.	295504.	345874.
NEW SEPARATE SEWER AREA						

J. Bailey and R. Waltman, "Flow Reduction of Wastewater from Households", Water and Sewage Works, March, 1971.

TABLE A-6-3 (Cont'd.)

CUYAHOGA RIVER WATERSHED

AKRON	1970	1980	1990	2000	2010	2020
POPULATION	344877.	376292.	418211.	453304.	470361.	471068.
FLOW (MGD)	53.80	60.21	68.59	76.16	80.90	82.44
BOD (LBS/YR)	13882000.	20601970.	24423500.	26472940.	29135830.	29229760.
SUSPENDED SOLIDS (LBS/YR)	28952400.	31589700.	36635260.	39709410.	42920430.	42984940.
ORGANIC NITROGEN (LBS/YR)	1837849.	2005260.	2228645.	2415656.	2506553.	2510320.
AMMONIA NITROGEN (LBS/YR)	1221037.	1332261.	1480676.	1604922.	1665312.	1667816.
TOTAL PHOSPHORUS AS P (LBS/YR)	1460209.	1593213.	1770704.	1919288.	1991507.	1994501.
SULFATE (LBS/YR)	4619799.	5040618.	5602144.	6072232.	6300719.	6310189.
CHLORIDE (LBS/YR)	5790484.	6317981.	7021761.	7610372.	7897360.	7909230.
COMBINED SEWER AREA						

MACEDONIA	1970	1980	1990	2000	2010	2020
POPULATION	9064.	15843.	25557.	30520.	33169.	35566.
FLOW (MGD)	1.00	2.26	3.19	3.97	4.64	5.33
BOD (LBS/YR)	562421.	1238313.	1725735.	2116560.	2300269.	2531409.
SUSPENDED SOLIDS (LBS/YR)	595505.	1272711.	1772377.	2172260.	2360802.	2596317.
ORGANIC NITROGEN (LBS/YR)	48302.	100481.	136193.	162681.	176758.	189531.
AMMONIA NITROGEN (LBS/YR)	32091.	66731.	90484.	108056.	117435.	125921.
TOTAL PHOSPHORUS AS P (LBS/YR)	38377.	79802.	108208.	129222.	140437.	150586.
SULFATE (LBS/YR)	121417.	252478.	342349.	408831.	444315.	476424.
CHLORIDE (LBS/YR)	152184.	316458.	429102.	512431.	556907.	597153.
NEW SEPARATE SEWER AREA						

GREENWOOD	1970	1980	1990	2000	2010	2020
POPULATION	2799.	4560.	6080.	8240.	9600.	10160.
FLOW (MGD)	0.33	0.55	0.76	1.07	1.34	1.52
BOD (LBS/YR)	186088.	299592.	410552.	571844.	665760.	723138.
SUSPENDED SOLIDS (LBS/YR)	197038.	307918.	421648.	586482.	683280.	741680.
ORGANIC NITROGEN (LBS/YR)	15982.	24300.	32400.	43911.	51158.	54143.
AMMONIA NITROGEN (LBS/YR)	10618.	16145.	21526.	29174.	33989.	35971.
TOTAL PHOSPHORUS AS P (LBS/YR)	12698.	19307.	25743.	34888.	40646.	43017.
SULFATE (LBS/YR)	40173.	61083.	81445.	110379.	128597.	136098.
CHLORIDE (LBS/YR)	50353.	76562.	102083.	138349.	161184.	170586.
NEW SEPARATE SEWER AREA						

(3) H & E, Ltd., "Feasibility Study for Wastewater Management Program", for Department of the Army, July, 1971.

TABLE A-6-3 (Cont'd.)

CUYAHOGA RIVER WATERSHED

STREETSBORO	1970	1980	1990	2000	2010	2020
POPULATION	4779.	8950.	12595.	15585.	18120.	19850.
FLOW (MGD)	0.53	1.07	1.57	2.03	2.54	2.98
BOD (LBS/YR)	296537.	588015.	850477.	1080819.	1256621.	1412823.
SUSPENDED SOLIDS (LBS/YR)	313980.	604349.	873463.	1109262.	1289690.	1449049.
ORGANIC NITROGEN (LBS/YR)	25467.	47695.	67119.	83052.	96561.	105781.
AMMONIA NITROGEN (LBS/YR)	16920.	31687.	44593.	55179.	64154.	70279.
TOTAL PHOSPHORUS AS P (LBS/YR)	20234.	37894.	53327.	65987.	76720.	84045.
SULFATE (LBS/YR)	64017.	119890.	168716.	208769.	242726.	265901.
CHLORIDE (LBS/YR)	80239.	150270.	211470.	261672.	304235.	333281.
NEW SEPARATE SEWER AREA						

AURORA WESTERLY	1970	1980	1990	2000	2010	2020
POPULATION	1570.	10428.	15565.	20472.	24621.	25995.
FLOW (MGD)	0.17	1.25	1.95	2.66	3.45	3.90
BOD (LBS/YR)	97418.	685120.	1051026.	1419733.	1707465.	1850193.
SUSPENDED SOLIDS (LBS/YR)	103149.	704151.	1079432.	1457094.	1752399.	1897633.
ORGANIC NITROGEN (LBS/YR)	8367.	55571.	82946.	109095.	131205.	138527.
AMMONIA NITROGEN (LBS/YR)	5559.	36920.	55108.	72481.	87171.	92035.
TOTAL PHOSPHORUS AS P (LBS/YR)	6647.	44152.	65902.	86678.	104245.	110063.
SULFATE (LBS/YR)	21031.	139683.	208501.	274233.	329810.	348216.
CHLORIDE (LBS/YR)	26360.	175086.	261336.	343725.	413386.	436456.
NEW SEPARATE SEWER AREA						

TWINSBURG	1970	1980	1990	2000	2010	2020
POPULATION	6432.	9140.	12690.	14450.	15450.	15670.
FLOW (MGD)	0.71	1.10	1.59	1.88	2.16	2.35
BOD (LBS/YR)	399106.	600498.	856892.	1002107.	1071457.	1115312.
SUSPENDED SOLIDS (LBS/YR)	422582.	617178.	880051.	1028479.	1099653.	1143909.
ORGANIC NITROGEN (LBS/YR)	34276.	48707.	67625.	77004.	82333.	83505.
AMMONIA NITROGEN (LBS/YR)	22772.	32360.	44929.	51160.	54701.	55480.
TOTAL PHOSPHORUS AS P (LBS/YR)	27233.	38699.	53729.	61181.	65415.	66347.
SULFATE (LBS/YR)	86160.	122435.	169989.	193565.	206960.	209907.
CHLORIDE (LBS/YR)	107993.	153461.	213065.	242615.	259405.	263039.
NEW SEPARATE SEWER AREA						

TABLE A-6-3 (Cont'd.)

CUYAHOGA RIVER WATERSHED

SOLON CENTRAL	1970	1980	1990	2000	2010	2020
POPULATION	8250.	10720.	12925.	14190.	13820.	12600.
FLOW (MGD)	0.91	1.29	1.62	1.84	1.93	1.89
BOD (LBS/YR)	511912.	704304.	872761.	984076.	958417.	896805.
SUSPENDED SOLIDS (LBS/YR)	542025.	723868.	896349.	1009973.	983638.	919800.
ORGANIC NITROGEN (LBS/YR)	43964.	57127.	68877.	75618.	73647.	67185.
AMMONIA NITROGEN (LBS/YR)	29209.	37954.	45761.	50240.	48930.	44610.
TOTAL PHOSPHORUS AS P (LBS/YR)	34930.	45388.	54724.	60080.	58514.	53348.
SULFATE (LBS/YR)	110513.	143600.	173137.	190082.	185126.	168783.
CHLORIDE (LBS/YR)	138517.	179989.	217011.	238250.	232038.	211554.
NEW SEPARATE SEWER AREA						

BEDFORD HTS.	1970	1980	1990	2000	2010	2020
POPULATION	13213.	21427.	27824.	32030.	34280.	34400.
FLOW (MGD)	1.45	2.57	3.48	4.16	4.80	5.17
BOD (LBS/YR)	820239.	1407753.	1878814.	2221280.	2377317.	2454824.
SUSPENDED SOLIDS (LBS/YR)	868488.	1446858.	1929593.	2279734.	2439878.	2517768.
ORGANIC NITROGEN (LBS/YR)	70444.	118184.	148274.	170688.	182678.	183797.
AMMONIA NITROGEN (LBS/YR)	46802.	75362.	98511.	113402.	121368.	122112.
TOTAL PHOSPHORUS AS P (LBS/YR)	55969.	90722.	117807.	135615.	145141.	146031.
SULFATE (LBS/YR)	177075.	287025.	372716.	429058.	459198.	462011.
CHLORIDE (LBS/YR)	221947.	359759.	467165.	537784.	575561.	579087.
NEW SEPARATE SEWER AREA						

BEDFORD	1970	1980	1990	2000	2010	2020
POPULATION	17552.	20500.	23300.	26400.	27800.	27800.
FLOW (MGD)	2.78	3.28	3.92	4.48	4.78	4.86
BOD (LBS/YR)	960972.	1122374.	1395760.	1581760.	1724990.	1724990.
SUSPENDED SOLIDS (LBS/YR)	1473490.	1720975.	2033640.	2312640.	2536750.	2536750.
ORGANIC NITROGEN (LBS/YR)	93534.	109244.	127363.	140686.	148146.	148146.
AMMONIA NITROGEN (LBS/YR)	62143.	72580.	84618.	93469.	98426.	98426.
TOTAL PHOSPHORUS AS P (LBS/YR)	74315.	86797.	101192.	111777.	117705.	117705.
SULFATE (LBS/YR)	235118.	274608.	320152.	353681.	372395.	372395.
CHLORIDE (LBS/YR)	294698.	344195.	401281.	443256.	466762.	466762.
COMBINED SEWER AREA						

TABLE A-6-3 (Cont'd.)

CUYAHOGA RIVER WATERSHED

SOUTHERLY	1970	1980	1990	2000	2010	2020
POPULATION	651209.	734054.	845622.	926440.	973253.	974410.
FLOW (MGD)	101.59	117.45	138.68	155.64	167.40	170.52
BOD (LBS/YR)	35653660.	40189440.	49384300.	54104080.	60390340.	60462130.
SUSPENDED SOLIDS (LBS/YR)	54668990.	61623810.	74076460.	81156130.	88809330.	88914910.
ORGANIC NITROGEN (LBS/YR)	3470291.	3911773.	4506319.	4936998.	5186464.	5192631.
AMMONIA NITROGEN (LBS/YR)	2305605.	2598916.	2993923.	3280059.	3445801.	3449897.
TOTAL PHOSPHORUS AS P (LBS/YR)	2757218.	3107983.	3580361.	3922545.	4120751.	4125650.
SULFATE (LBS/YR)	8723269.	9833018.	11327530.	12410120.	13037210.	13052710.
CHLORIDE (LBS/YR)	10933800.	12324760.	14197390.	15554930.	16340920.	16360340.
COMBINED SEWER AREA						

RICHFIELD	1970	1980	1990	2000	2010	2020
POPULATION	0.	5560.	8880.	10620.	11430.	12150.
FLOW (MGD)	0.00	0.67	1.11	1.38	1.60	1.82
BOD (LBS/YR)	0.	365292.	599622.	736497.	792670.	864776.
SUSPENDED SOLIDS (LBS/YR)	0.	375439.	615828.	755878.	813530.	886950.
ORGANIC NITROGEN (LBS/YR)	0.	29629.	47322.	56594.	60910.	64747.
AMMONIA NITROGEN (LBS/YR)	0.	19685.	31440.	37600.	40468.	43017.
TOTAL PHOSPHORUS AS P (LBS/YR)	0.	23541.	37598.	44965.	48395.	51443.
SULFATE (LBS/YR)	0.	74479.	118952.	142260.	153110.	162755.
CHLORIDE (LBS/YR)	0.	93352.	149095.	178310.	191910.	203998.

TABLE A-6-4

MUNICIPAL WASTE LOAD PROJECTIONS

Constituent	Watershed	Year 1970	1980	1990	2000	2010
Population	Chagrin	10,209	22,718	49,292	66,614	79,9
	Cuyahoga	1,115,702	1,316,854	1,556,035	1,745,725	1,857,7
	Rocky	208,001	301,029	381,115	440,360	481,6
	Lake Erie	829,736	936,870	1,092,055	1,210,188	1,292,2
	TOTAL	2,163,648	2,577,471	3,078,437	3,462,887	3,711,6
Flow (MGD)	Chagrin	1.12	2.73	6.16	8.66	11.
	Cuyahoga	169.36	203.26	244.73	280.38	307.
	Rocky	22.88	36.12	47.64	57.25	67.
	Lake Erie	119.55	138.54	164.89	187.07	206.
	TOTAL	312.91	380.65	463.42	533.36	592.
BOD (Lbs/Yr.)	Chagrin	633,468	1,492,572	3,328,422	4,619,679	5,546,1
	Cuyahoga	61,829,710	74,134,500	93,320,710	105,668,760	118,093,2
	Rocky	12,906,460	19,777,600	25,734,770	30,538,940	33,404,7
	Lake Erie	46,997,300	54,404,030	67,099,670	75,357,760	83,681,7
	TOTAL	122,366,938	149,808,702	189,483,592	216,185,139	240,725,8
Suspended Solids (Lbs/Yr.)	Chagrin	670,731	1,534,032	3,418,398	4,741,250	5,692,1
	Cuyahoga	91,800,514	107,494,700	126,699,048	142,201,377	151,007,5
	Rocky	13,665,660	20,326,980	26,430,300	31,342,610	34,283,7
	Lake Erie	65,733,090	73,984,560	89,016,610	98,988,190	108,287,3
	TOTAL	171,869,995	203,340,272	245,564,356	277,273,427	299,270,7
Organic Nitrogen (Lbs/Yr.)	Chagrin	54,404	121,064	262,677	354,986	426,1
	Cuyahoga	5,945,575	7,017,515	8,292,110	9,302,968	9,899,9
	Rocky	1,108,437	1,604,183	2,030,961	2,346,677	2,566,8
	Lake Erie	4,421,661	4,992,578	5,819,559	6,449,090	6,866,1
	TOTAL	11,530,077	13,735,340	16,405,307	18,453,721	19,759,1
Ammonia Nitrogen (Lbs/Yr.)	Chagrin	36,145	80,433	174,518	235,847	283,1
	Cuyahoga	3,950,142	4,662,320	5,509,140	6,180,737	6,577,3
	Rocky	736,427	1,065,793	1,349,337	1,559,093	1,705,3
	Lake Erie	2,937,679	3,316,986	3,866,419	4,284,669	4,575,0
	TOTAL	7,660,393	9,125,532	10,899,414	12,260,346	13,140,9
Total Phosphorus as P (Lbs/Yr.)	Chagrin	43,225	96,188	208,702	282,044	338,6
	Cuyahoga	4,723,881	5,575,558	6,588,250	7,155,897	7,597,7
	Rocky	880,676	1,274,556	1,613,639	1,864,482	2,039,4
	Lake Erie	3,513,100	3,966,706	4,623,759	5,123,933	5,471,1
	TOTAL	9,160,882	10,913,008	13,034,350	14,426,356	15,447,0

TABLE A-6-4

AL WASTE LOAD PROJECTIONS

	Year			
	1990	2000	2010	2020
718	49,292	66,614	79,974	90,261
854	1,556,035	1,745,725	1,857,744	1,885,929
029	381,115	440,360	481,683	505,925
870	1,092,055	1,210,188	1,292,205	1,320,333
471	3,078,437	3,462,887	3,711,606	3,802,448
.73	6.16	8.66	11.20	13.54
.26	244.73	280.38	307.17	319.72
.12	47.64	57.25	67.44	75.89
.54	164.89	187.07	206.91	219.24
.65	463.42	533.36	592.72	628.39
572	3,328,422	4,619,679	5,546,196	6,424,325
500	93,320,710	105,668,760	118,093,200	120,787,330
600	25,734,770	30,538,940	33,404,700	36,009,180
030	67,099,670	75,357,760	83,681,760	86,870,190
702	189,483,592	216,185,139	240,725,856	250,091,025
032	3,418,398	4,741,250	5,692,147	6,589,051
700	126,699,048	142,201,377	151,007,511	153,790,455
980	26,430,300	31,342,610	34,283,760	36,932,500
560	89,016,610	98,988,190	108,287,360	111,669,990
272	245,564,356	277,273,427	299,270,778	308,981,996
064	262,677	354,986	426,181	481,001
515	8,292,110	9,302,968	9,899,917	10,050,114
183	2,030,961	2,346,677	2,566,888	2,696,073
578	5,819,559	6,449,090	6,866,158	7,062,697
340	16,405,307	18,453,721	19,759,144	20,289,885
433	174,518	235,847	283,148	319,569
320	5,509,140	6,180,737	6,577,341	6,677,130
793	1,349,337	1,559,093	1,705,398	1,791,226
986	3,866,419	4,284,669	4,575,049	4,674,637
532	10,899,414	12,260,346	13,140,936	13,462,562
188	208,702	282,044	338,610	382,165
558	6,588,250	7,155,897	7,597,766	7,698,847
556	1,613,639	1,864,482	2,039,444	2,142,085
706	4,623,759	5,123,933	5,471,194	5,611,456
008	13,034,350	14,426,356	15,447,014	15,834,553

MUNICIPAL WASTE LOAD PROJECTIONS

Constituent	Watershed	Year 1970	1980	1990	2000	2010
Sulphate (Lbs/Yr.)	Chagrin	136,755	304,319	660,291	892,328	1,071,291
	Cuyahoga	14,945,388	17,639,919	20,843,858	23,384,856	24,885,402
	Rocky	2,786,275	4,032,433	5,105,225	5,898,841	6,452,384
	Lake Erie	11,114,725	12,549,839	14,628,620	16,211,072	17,309,729
	TOTAL	28,983,143	34,526,510	41,237,994	46,387,097	49,718,806
Chloride (Lbs/Yr.)	Chagrin	171,409	381,435	827,613	1,118,449	1,342,763
	Cuyahoga	18,732,633	22,109,974	26,125,810	29,310,713	31,191,500
	Rocky	3,492,335	5,054,276	6,398,920	7,393,643	8,087,457
	Lake Erie	3,780,771	5,150,768	6,943,185	8,298,776	9,393,853
	TOTAL	26,177,148	32,696,453	40,295,528	46,121,581	50,015,573

AL WASTE LOAD PROJECTIONS

0	Year 1990	2000	2010	2020
,319	660,291	892,328	1,071,291	1,209,091
,919	20,843,858	23,384,856	24,885,402	25,262,945
,433	5,105,225	5,898,841	6,452,384	6,777,117
,839	14,628,620	16,211,072	17,309,729	17,753,498
,510	41,237,994	46,387,097	49,718,806	51,002,651
,435	827,613	1,118,449	1,342,763	1,515,481
,974	26,125,810	29,310,713	31,191,500	31,664,730
,276	6,398,920	7,393,643	8,087,457	8,494,479
,768	6,943,185	8,298,776	9,393,853	10,040,770
,453	40,295,528	46,121,581	50,015,573	51,715,460

7. Reuse Potential - Water quality requirements are dependent upon the use for which the water is intended. Throughout the study area the water usage varies widely from the industrialized urban areas to the rural farmlands. In an attempt to categorize water usage, the following groups were selected:

1. Public water supply - residential and commercial consumption.
2. Irrigation.
3. Agricultural - livestock consumption.
4. Recreation - swimming, boating, etc.
5. Fish - sustain fish and other aquatic life.
6. Industrial I - Cooling Water.
7. Industrial II - Boiler Feed Water (150-250 psi).
8. Industrial III - Food Processing Industry consumption.
9. Industrial IV - Steel Manufacture, General Industrial consumption.

Each of these categories requires a different quality of water. The importance of defining the water quality criteria is to give insight to the potential of waters in regard to their reuse by certain water consumption categories. Tables A-7-1 and A-7-2 summarize the allowable values of various water quality parameters by water usage category. The principle sources of this data were Water Quality Criteria by McKee and Wolf and the Report of the Committee on Water Quality Criteria, F.W.P.C.A.

TABLE A-7-1

DOMESTIC WATER QUALITY REQUIREMENTS

	Public Water Supply	Irrigation	Agricultural	Recreation	Fish
Biochemical Oxygen Demand (monthly average), mg/l	1.5 - 2.5	-	-	*	*
Fecal Coliform, MPN per 100 ml (monthly average)	5,000	*	*	200	*
Dissolved Oxygen, mg/l	≥ 4	*	*	*	≥ 5
pH (average)	6.0 - 8.5	6 - 9	*	6.5 - 8.3	6.0 - 9.0
Chlorides (max.), mg/l	250	100	1500	-	400
Fluorides, mg/l	1.7	10.0	1.0	*	1.5
Phenolic Compounds, (max.) mg/l	.001	50	1000	*	0.2
Color, units ($^{\text{platinum-cobalt}}_{\text{standard}}$)	75	-	-	*	*
Turbidity, Jackson Units	10 - 250	-	-	*	50
Ammonia, mg/l	0.5	*	*	*	1.0
Dissolved Solids, mg/l	500	1000	2500	*	2000
Temperature, °F	85	-	-	85	$\leq 5°$ greater than monthly average

*No data available
-Not a critical parameter

TABLE A-7-2

INDUSTRIAL WATER QUALITY REQUIREMENTS

	Industrial			
	I Cooling Water	II Boiler Feed	III Food Processing	IV Steel Manu.
Turbidity, Jackson Units	50	10	1-10	*
Hardness, mg/l as $CaCO_3$	50	40	10-250	*
Iron, mg/l	0.5	*	0.2	-
Manganese, mg/l	0.5	*	0.2	-
Iron and Manganese, mg/l	0.5	*	0.2-0.3	-
pH	6.5-7.5	8.4	*	5 - 9
Fluoride, mg/l	*	*	1.0	*
Dissolved Solids, mg/l	*	50-3000	850	1500
Chlorides, mg/l	*	*	50	175
Color, units (platinum-cobalt standard)	-	2-80	10	-
Temperature, °F	100	120	*	100

*No data available
-Not a critical parameter

There are several areas where reuse is presently being practiced either directly or indirectly. In the lower Cuyahoga River area, the effluent from the Southerly Plant along with the flow of Cuyahoga River water is being used for cooling purposes. In the upper Cuyahoga and in the Rocky and the Chagrin Rivers water is withdrawn for public water supply, and at least part of the volume withdrawn has had prior use. With development of the upper watersheds, it will become even more critical in the future to protect this reuse requirement by improving wastewater treatment. Table A-7-3 shows withdrawal and upstream uses.

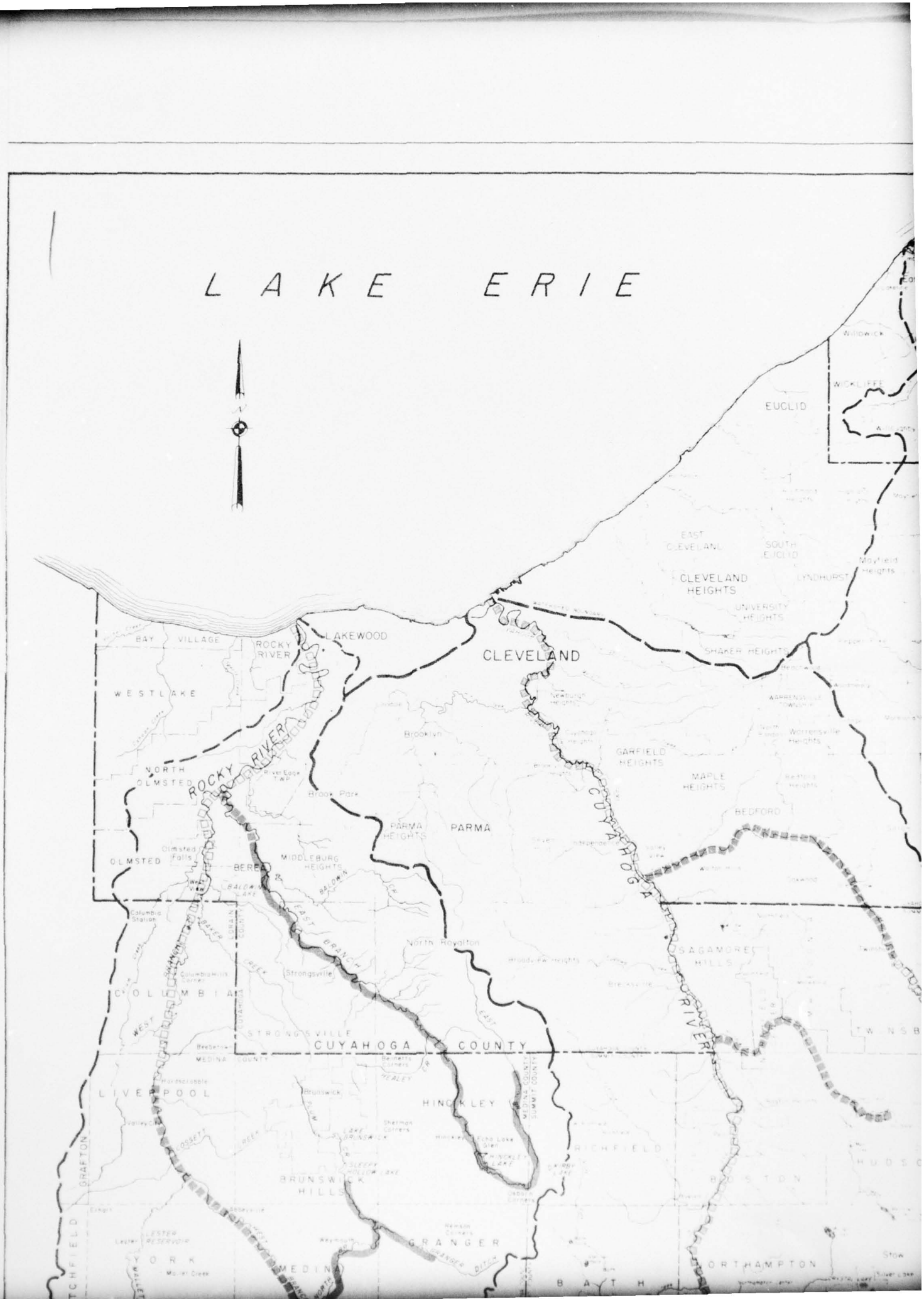
TABLE A-7-3

PRESENT REUSE

Withdrawal	Use	Prior Major Users
Lake Rockwell - Cuyahoga River	Public Water Supply for Akron	Mantua, Burton, Middlefield
Willoughby - Chagrin River	Public Water Supply for Willoughby	Chagrin Falls, Aurora, Chesterland
West Branch Rocky River	Medina Water Supply	Agricultural only
East Branch Rocky River	Berea Water Supply	Brunswick, Strongsville, North Royalton
Lower Rocky River	Recreation	Medina, Brunswick, Berea, North Royalton, Strongsville, North Olmsted, Brookpark, Middleburg Heights
Lower Chagrin River	Recreation	Chagrin Falls, Aurora, Chesterland
Lower Cuyahoga River	Industrial Water Supply and Cooling	Akron, Cleveland sewerage district, Central Cuyahoga River Watershed Communities

8. Stream Flow Quality - The feasibility report indicates major stream quality conditions and Figure A-8-1 indicates the general water quality zones. Additional information on the Cuyahoga River indicates that the reach from the Ohio Edison dam to the confluence with the Little Cuyahoga River does not continuously meet the temperature standard for Aquatic Life "A", stated in the Feasibility Report.

The stream water quality criteria has been revised by the Ohio Water Pollution Control Board. The revision upgrades the Aquatic Life "B" classification to Aquatic Life "A" class, and modifies the industrial water supply, recreation, and aquatic life criteria. The most recent water quality criteria is shown in Table A-8-1.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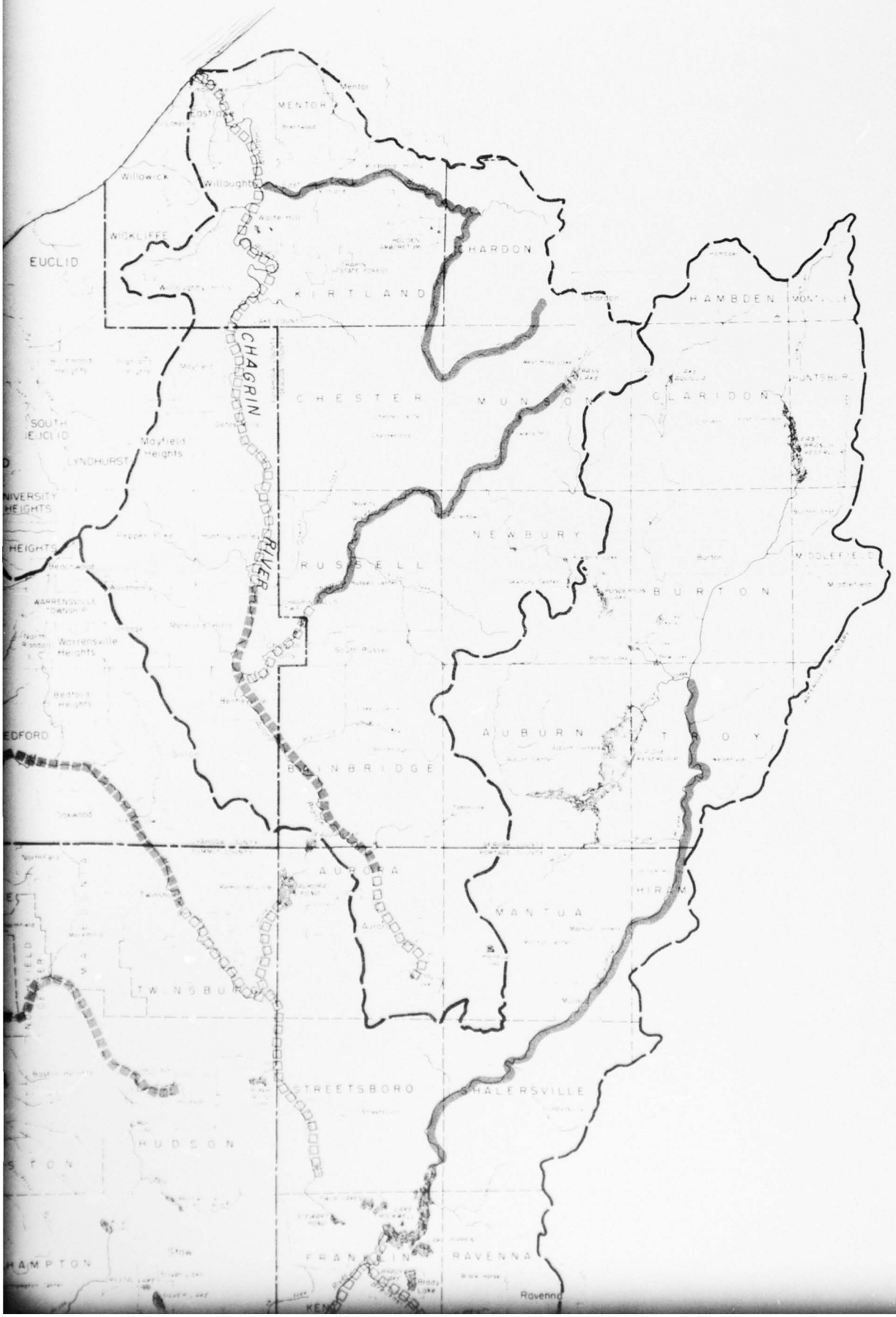
EUCLID
WICKLIFFE
EAST CLEVELAND
SOUTH EUCLID
CLEVELAND HEIGHTS
LYNDHURST
Mayfield Heights
UNIVERSITY HEIGHTS
SHAKER HEIGHTS
BAY VILLAGE
ROCKY RIVER
LAKEWOOD
CLEVELAND
WESTLAKE
Brooklyn
GARFIELD HEIGHTS
Warrensville Heights
MAPLE HEIGHTS
NORTH OLMSTED
ROCKY RIVER
River Edge TWP.
Brook Park
PARMA HEIGHTS
PARMA
BEDFORD
OLMSTED
Olmsted Falls
BEREA
MIDDLEBURG HEIGHTS
CUYAHOGA RIVER
EAST BRANCH
North Royalton
SAGAMORE HILLS
COLUMBIA
Strongsville
STRONGSVILLE
CUYAHOGA COUNTY
LIVERPOOL
HINCKLEY
RICHFIELD
BRUNSWICK HILLS
GRANGER
YORK
MEDINA
NORTHAMPTON
BATH
GRAFTON


MENTOR
Willowick
Willoughby
WICKLIFFE
EUCLID
KIRTLAND
CHARDON
HAMBDEN
CHAGRIN
RIVER
CHESTER
MUNSON
CLARIDON
SOUTH EUCLID
LYNDHURST
Mayfield Heights
NEWBURY
RUSSELL
BURTON
Warrensville Heights
AUBURN
BAINBRIDGE
AURORA
MANTUA
TWINSBURG
STREETSBORO
HALERSVILLE
HUDSON
FRANKLIN
RAVENNA
Ravenna

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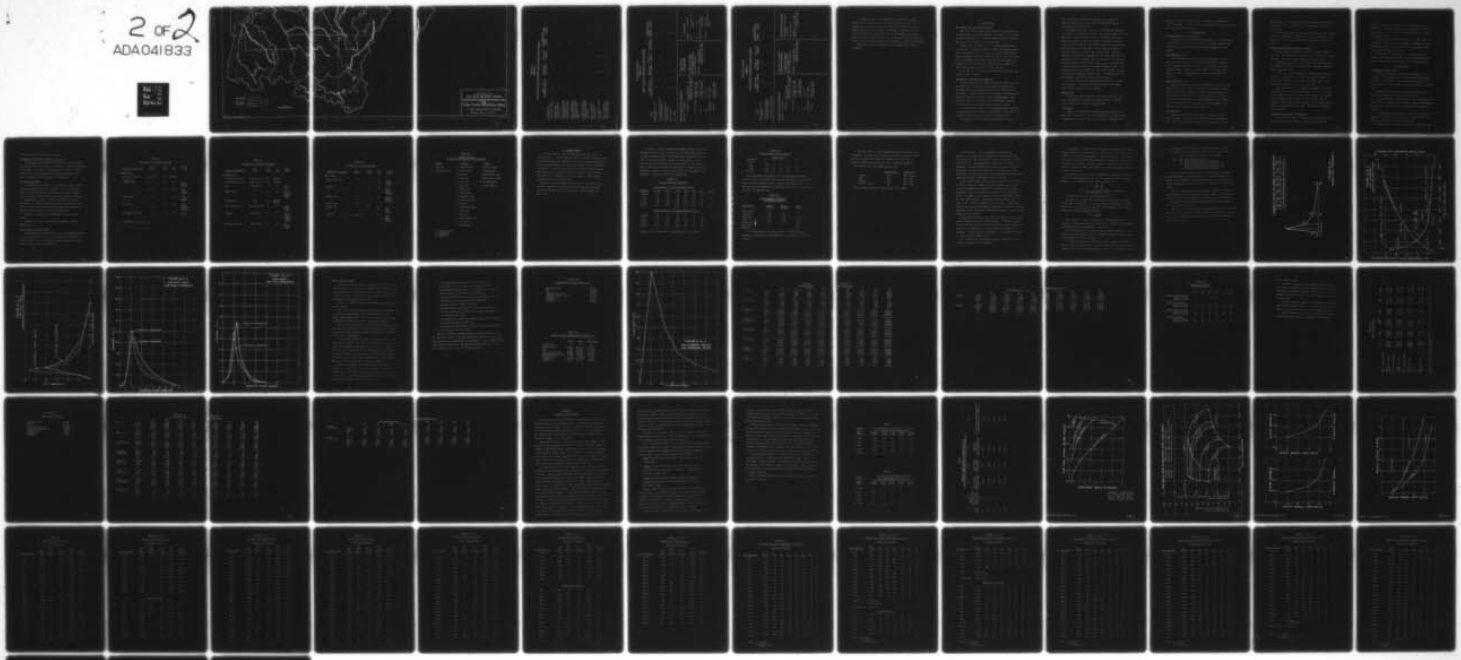

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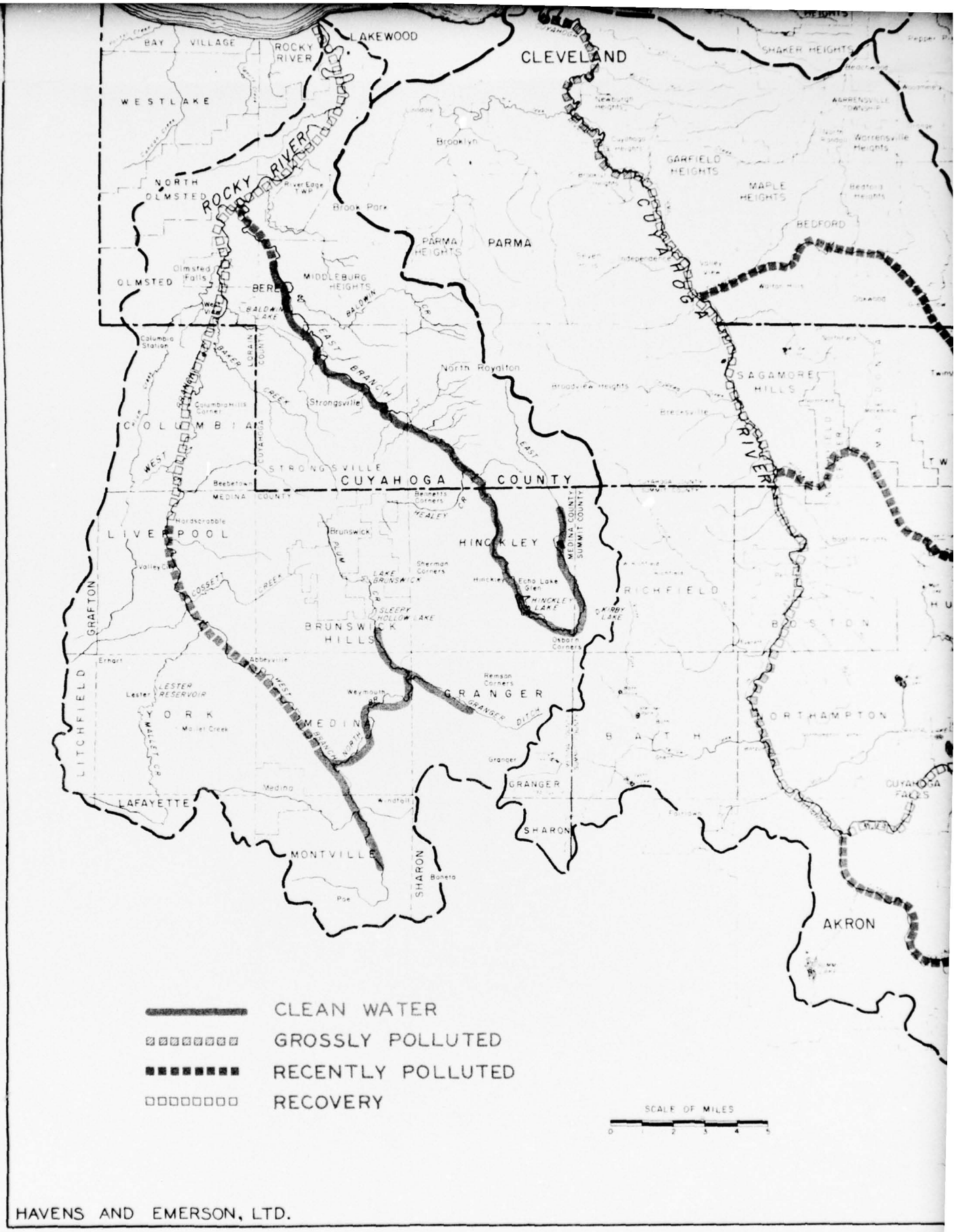


HAVENS AND EMERSON, LTD.

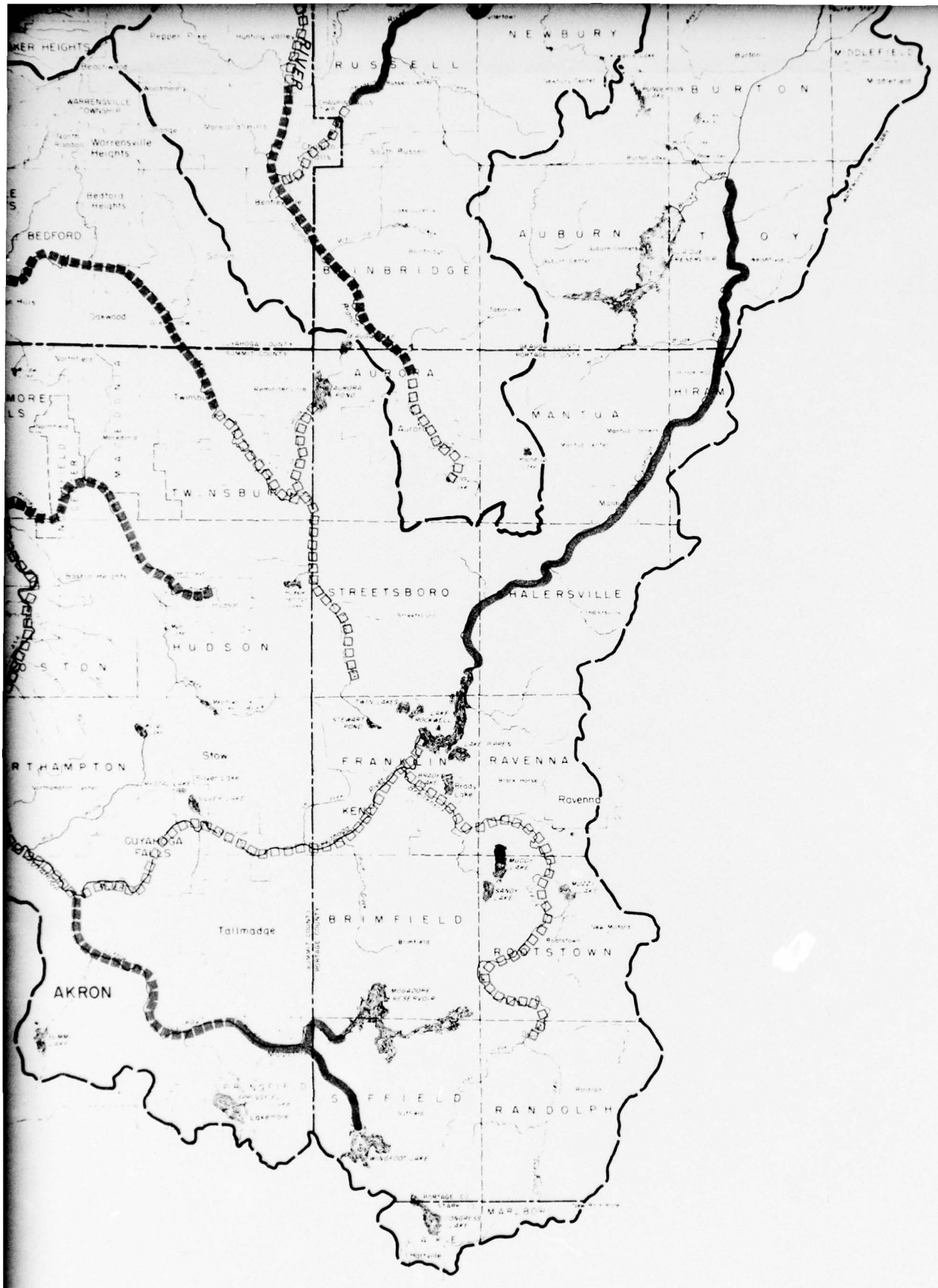

NEWBURY
RUSSELL
BURTON
Warrensville Heights
BEDFORD
AUBURN
BAINBRIDGE
AURORA
MANTUA
HIRAM
STREETSBORO
HALEVSVILLE
HUDSON
Stow
FRANKLIN
RAVENNA
Ravenna
CUYAHOGA FALLS
Tallmadge
BRIMFIELD
AKRON
RANDOLPH

FIGURE A-8-1

SURVEY SCOPE STUDY

WASTE WATER MANAGEMENT PROGRAM

CLEVELAND-AKRON METROPOLITAN AND THREE RIVERS WATERSHED AREAS

U. S. ARMY ENGINEER DISTRICT, BUFFALO

WATER QUALITY ZONES

TABLE A-8-1

SUMMARY OF

CUYAHOGA RIVER OHIO DEPARTMENT OF HEALTH WATER QUALITY STANDARDS

	Aquatic Life Warm Water Fisheries	Industrial Water Supply	Public Water Supply	Recreation Secondary Contact	Recreation Primary Contact
Cuyahoga River from S.R. 17 to Coast Guard Station:	X	X			
Cuyahoga River from Lake Rockwell Down to S.R. 17:	X			X	
Little Cuyahoga River upstream of S.R. 91 and downstream of Hazel Street, Akron:	X	X		X	
Little Cuyahoga River between S.R. 91 and Hazel Street; Summit Lake and the Ohio Canal:	X	X			
All other tributaries between Lake Rockwell and Harvard Avenue, Cleveland:	X	X		X	
Upper Cuyahoga River Basin above Lake Rockwell Dam:	X	X	X		X
Lakes, Hodgson, Muzzy and Sandy	X	X	X		X
Lakes, currently in use for swimming and water contact sports	X	X			X

TABLE A-8-1 (Cont'd.)

SUMMARY OF

CHAGRIN RIVER OHIO DEPARTMENT OF HEALTH STANDARDS

Reach	Aquatic Life Warm Water Fisheries	Industrial Water Supply	Public Water Supply	Cold Water Fish-Seasonal	Recreation Secondary Contact	Recreation Primary Contact
Chagrin River and all tributaries	X	X			X	
East Branch and Main Stem near Daniels Park	X	X	X		X	
Main Stem upstream of Chagrin Falls	X	X			X	
Aurora Branch	X	X			X	
East Branch	X	X		X	X	

Chagrin River and all tributaries:

Requires: 4 freedoms:

Bacteria: Fecal Coliforms
1,000/100 ml, mo. geo. mean
2,000/100 ml, 10% samples

Diss. Solids: 500 mg/l, mo. avg.
750 mg/l, any time

D.O.: 5.0 mg/l, daily avg.
4.0 mg/l, any time

pH: 6.0 - 8.5

Temperature: 90°F. (Max.)

Toxicity: 1/10 96 hr. median tolerance limit

East Branch and Main Stem near Daniels Park:

In addition, required threshold odor number: Not to exceed 24 at 60°C as a daily average.

Bacteria: Total Coliforms
5,000/100 ml, mo. avg.
20,000/100 ml, 5% samples

East Branch:

Requires: 4 freedoms

D.O.: 6.0 mg/l, all times

pH: 6.5-8.5

Temperature: Natural, no heat added

Toxicity: 1/10 96 hr. median tolerance limit.

TABLE A-8-1 (Cont'd.)

SUMMARY OF

ROCKY RIVER OHIO DEPARTMENT OF HEALTH STANDARDS

Reach	Aquatic Life Warm Water Fisheries	Industrial Water Supply	Public Water Supply	Recreation Secondary Contact	Recreation Primary Contact
Rocky River and all tributaries	X	X		X	
East Branch and Baldwin Creek near reservoir	X	X	X		
East Branch at Albion Park	X	X		X	X

Rocky River and all tributaries:

Requires: 4 freedoms:

Bacteria: Fecal Coliforms
1,000/100 ml, mo. geo. mean
2,000/100 ml, 10% samples

Diss. Solids: 500 mg/l, mo. avg.
750 mg/l, any time

D.O.: 5.0 mg/l, daily avg.
4.0 mg/l, any time

pH: 6.0 - 8.5

Temperature: 90°F. (Max.)

Toxicity: 1/10 96 hr. median tolerance limit

East Branch and Baldwin Creek near reservoir:

In addition, requires threshold odor number: Not to exceed 24 at 60°C as a daily average.

Bacteria: Total Coliforms
5,000/100 ml, mo. avg.
20,000/100 ml, 5% samples

East Branch at Albion Park:

Same as Rocky River except coliforms.

Fecal Coliforms:

200/100 ml, mo. geo. mean
400/100 ml, in more than 10% of monthly sample

9. Sediment Deposits in the Three Rivers Watershed Area - Sediment deposits occur along rivers and streams where the velocity of the river is reduced due to an increase in cross sectional area. This can be caused by natural formations or man-made dams or impoundments. Tables A-9-1, A-9-2 and A-9-3 tabulate the characteristics of the impoundments in the Chagrin River Basin, the Cuyahoga River Basin, and the Rocky River Basin, respectively. Table A-9-4 lists the Natural Lakes and Impoundments for each of the watersheds.

Following is a written description of the sediment deposit areas by watershed.

a. CHAGRIN RIVER

Main Branch - Bass Lake to Aurora Branch

Bass Lake - The outlet for several miles has a low gradient and has been dredged. Most recent dredging or channeling is in the Butternut Road-Cochran Road reach. Banks and substrate are not stable and contribute silt and organics to the stream flow.

Chagrin Falls - Chase Bag Co. Two impoundments, approximately ten feet deep. A third dam, ten feet in height, but holding a narrow pool of an estimated five or six acres, is located below the Chase Bag Co. impoundment and in the center of the town. It also is nearly full, but flushing action of high flows keeps the pool depths at an estimated one to three foot depth. Much of the fill appears to be gravel and rock slabs to a size of at least one foot.

Below this dam is a steep section in which the river drops about 40 feet in about 150 yards.

Main Branch - Aurora Branch to Lake Erie

From the confluence of the Aurora Branch with the Main Branch of the Chagrin River near Chagrin Falls Village to State Route 84 at Willoughby, small sediment beds made up of sills, sand and gravel are frequent. North of Mayfield Road some channel clearing operations have been carried out to maintain a freely flowing channel. Bank erosion is common to this entire reach, with sediments building on the inside of curves at and below the outside curve cutbanks.

Dam at Gates Mills Village - This impoundment holds an estimated 12-15 surface acres of flowing pool, approximately six feet deep. It is about one-half filled with rock debris, and sandy gravel.

Construction of Interstate 90 was accompanied by relocation of

the river channel on the flood plain in that area. Erosion was rapid and locally severe in this reach for several years but now the banks seem to be stabilizing.

Willoughby Dam and Pool - This is a six foot high dam impounding the main River for Public Water Supply. There are two intakes, one in the Main Branch about 150 feet above the dam, and the other in the East Branch near the head of the backed up pool. In general, the entire pool is filled to within one and one-half to three feet of the surface with sand, gravel, silt and organic matter. Annually, usually in June, the dam gate is opened to lower the water level. Bulldozers are used to push some of the sediments out and below the dam from the dam fact to the first intake and for a 100 foot width. The remainder of the pool has not been cleaned for several years. A sediment island in the pool south of State Route 84 bridge was removed in 1965. Silt deposits below the East Branch intake were removed in 1963. This bed has not rebuilt as rapidly as prior to 1963. This may be due in part to operational improvements at the upstream gravel pits.

The last two miles of the river course is estuarine. Silt beds form throughout. Basin sludge and filter wash from the Willoughby water plant are added to the river sediments.

Aurora Branch

No serious sediment accumulations were found. Except for Sunny Lake, impoundments are located on intermittent streams. Sunny Lake does not appear to have unusual silting problems.

East Branch

Generally high gradient with eroding type but generally stable bed. One or two reaches in the lower two-thirds of the streams course accumulate gravel and silt. One is the reach near Booth Road, Kirt-

5. Hydrographs - A generalized unit graph was developed

land Hills Village, the other is at and just above the confluence and pool at Willoughby. Formerly a problem with washings from gravel operations were serious on the East Branch.

b. CUYAHOGA RIVER

From the Headwaters to Lake Rockwell

No sedimentation was found in this upper reach. As the river enters Lake Rockwell, as observed from State Route 14, extensive marshy island areas evidence sediment deposits in the lake area upstream from the highway.

Lake Rockwell to Kent

The reach from Lake Rockwell to Kent does not appear to have a sediment problem at this time, although Breakneck Creek, a tributary, has a continuing tendency to fill much of its own channel with silts including organics. Much of the organic matter is of natural origin. The creek channel east and northeast of Kent was dredged about two years ago.

Kent to Munroe Falls

From Kent to the Munroe Falls Dam, the Cuyahoga River is in a pool. Prior to 1969, a heavy organic load from the Kent Wastewater Treatment Plant helped to form a sludge bed and septic condition throughout the pool, a reach of about four miles. Improved treatment at the plant has removed the load and the river has shown marked recovery. Munroe Falls Dam has a height of approximately 12 feet. Measurement at the abutment indicated filling of about eight feet.

Old Gorge Reach

Through Cuyahoga Falls and North Akron the current scours and carries sediments at least as far as the Ohio Edison Generating Plant pool. Several small dams in the gorge reach do not appear to collect

at the beginning and end of the storm with rainfall depth of .01-inch.

much sediment. A few small marginal beds two to three inches deep occur in the upper pool at Cloverbrook Road. Sandstone bedrock is the substrate here.

The Ohio Edison dam holds a pool approximately 50 feet deep. Measurement at the State Route 59 bridge showed 23 feet of water over a soft substrate. It is not certain as to the distribution of sediment in the pool.

Akron Wastewater Treatment Plant to Peninsula

The reach above the treatment plant does not collect sludge or much silt. Sand and gravel and stable aluvial soil make up the stream substrate. Bars of gravel and sand build and shift at bends.

Although improved capacity and treatment at the Akron spill out has apparently reduced the solids load to the river some sludge still forms in downstream beds.

At Ira Road bridge the substrate is generally clean gravel and sand with a strong current. At Bolanz Road bridge the current is slower and sediments build on the left side of the channel. These sediment beds appeared to be one to two feet deep.

Septic conditions were also observed last summer in the flowing pool above the dam at Peninsula, State Route 303. The dam is about 12 feet high with the pool confined to the river bed. It is approximately one-half filled with silts, sand, gravel, rocks and some organics. This varies with flow conditions, with the lighter material building during moderate and low flow. These tend to be flushed out during high flows.

Peninsula to Station Road, Brecksville

Bank erosion is common. River meanders have cut banks and built up sediments on inside of bends. Previously there has been an

extensive sludge bed at the head of the pool behind the dam at Station Road. Summer conditions may make this bed evident again. Reduction in its size and activity would probably reflect treatment improvement at Akron.

The dam at Station Road diverts water into the Ohio Canal. The canal reach to the first lock and spillway at Alexander Road showed considerable septic activity on May 9 and 10, particularly in the quarter mile reach above the spillway.

Considerable aeration takes place at the spillways and no further septic bubbling was noticed throughout the remainder of the canal. The canal collects considerable silt and sludge sediments.

c. ROCKY RIVER

West Branch Above East Branch

In the upper watershed of the West Branch sediments are not a problem. The impoundment on the North Branch at the Medina Water Plant holds a pool about six feet deep and covering three to four surface acres. It is about eighty percent filled with silt, sand and gravel.

At Fenn Road a fallen tree is forcing a new channel cut that has removed about ten feet of bank in the past year.

In the low gradient reaches from this vicinity to Westview near Berea the river accumulates silts and heavier sediments during moderate and low flows. High flows tend to move these with final deposit in Lake Erie.

A low dam at Westview, maintained to supply irrigation water for greenhouse use in that area, collects rocks, gravel and tree debris. The pool is narrow and confined to the river bed.

The next reach to the confluence with the East Branch is a high

gradient and does not collect light sediments.

West Branch - East Branch Confluence to Lake Erie

Re-channeling of some reaches of Rocky River below the confluence has kept the current sufficient to prevent further sediment bed formation to the mouth. The estuary at the mouth collects sediment and sludge from three upstream wastewater plants and combined sewerage system. Septic conditions occur at the head of the estuary pool

East Branch Above Berea

No sediment beds were found to the impoundments at Berea. These are abandoned quarry holes and are reported to be 70 to 90 feet in depth, the general thickness of the sandstone in the area. Baldwin Lake on the river is used as public water supply by the City of Berea.

Sediments have collected to nearly the total capacity of the reservoir lake. Dredging in 1961 removed a few feet of the top layers. Much of this capacity has been lost to refilling. Water depths over large areas of the reservoir are only one to three feet.

Disposal of this large volume of sediments would be a serious problem.

Included in the area is Wallace Lake, a recreation lake near Baldwin Lake.

Berea Confluence with West Branch

This reach collects silts and sludge in low flow periods particularly in short low gradient sections. This sludge originates from the Berea Wastewater Plant. Recent improvements in effluent quality have reduced the size and impact of these sludge beds.

TABLE A-9-1

IMPOUNDMENTS IN CHAGRIN RIVER BASIN

Location of Impoundment	Dam Height	Pool Acres	% Fill	Type of Fill
CHAGRIN RIVER:				
Sunny Lake, Aurora	less than 10'	65	Unknown	-
Chase Bag Co., Chagrin Falls	(1) 10'	16.5	90	silt, gravel, cobbles
	(2) 10'	14.7	90	silt, gravel, cobbles
Chagrin Falls	10'	5	85	silt, gravel, cobbles
Gates Mills	6'	10	50	silt, gravel, cobbles, boulders
Willoughby Water Plant	6'	8	80	silt, gravel

*Impoundment raises natural ponds

TABLE A-9-2

IMPOUNDMENTS IN CUYAHOGA RIVER BASIN

Location of Impoundment	Dam Height	Pool Acres	% Fill	Type of Fill
CUYAHOGA RIVER:				
East Branch Reservoir	greater than 10'	400	Unknown	
Lake Rockwell Reservoir	greater than 10'	736	Unknown	
Kent	less than 5'	5	10	silt, gravel
Munroe Falls	8'	96	50	silt, gravel, sludge, lime
Cuyahoga Falls	12'	10	Unknown	
	10'	2	Unknown	
Ohio Edison Power	greater than 50'	38	50	silt, gravel, sludge
Peninsula	less than 10'	10	50	silt, gravel, cobbles, boulders, sludge
Canal Diversion Dam	less than 10'	15	50	silt, gravel, sludge

TABLE A-9-3

IMPOUNDMENTS IN ROCKY RIVER BASIN

Location of Impoundment	Dam Height	Pool Acres	% Fill	Type of Fill
ROCKY RIVER:				
Medina Water Plant	7'	6	80	silt, gravel, sand
Westview	8'	6	40	silt, sand, gravel, cobbles
Olmsted Falls	4'	1	40	gravel, cobbles, boulders
Hinckley Lake	18'	81		
Baldwin Lake	7'	33	95	silt, sand, gravel
Oxbow Dam	less than 10'	1	70	silt, sand, gravel, cobbles

TABLE A-9-4

NATURAL LAKES AND
IMPOUNDMENTS ON TRIBUTARIES OF THREE RIVERS

	Chagrin		Cuyahoga		Rocky
N	Bass Lake	I	LaDue Reservoir	I	Montiville Lakes
I	Lake Lucerne(s)	I	Restfull Lake	I	Lake Brunswick
		N	Punderson	I	Sleepy Hollow Lake
		N	Sandy Lake	Q	Wallace Lake - Quarry
		NI	Muddy Lake	Q	Coe Reservation
		N	Muzzy Lake	I	Lester Lakes(s)
		I	Mogadore Res.		
		I	Lower Mogadore		
		N	Springfield Lake		
		I	Massilon Road Gage		
		NI	Wyoga Lake		
		I	Meadowbrook Lake(s)		
		I	Lake Forest		
		I	Pine Lake		
		I	Hudson Springs Lake		
		NI	Aurora Pond		
		I	Ghent Millpond		

s = sediment problem
N = Natural Lake
I = Impoundment
Q = Quarry

B - STORMWATER RUNOFF

1. Drainage District - The study area was divided into 162 storm drainage districts. The work maps used for this were USGS 1:24000 topographic maps and the land use maps prepared for this study. The drainage districts used in present urban areas were those that are defined by the local storm sewer system. In areas where storm sewer systems have not been installed, then the district was laid out according to normal engineering practice. The districts were identified by the type of systems - natural channel, separate storm sewer or combined sewer.

Future districts were considered to be separate. The 162 districts divide the study area into storm sewer districts that would be capable of providing drainage for the 2020 urban area. Rural areas were not sub-divided.

2. Rainfall - Rainfall intensities and depths were based on the local raingage records and U.S.W.B. Bulletin 40. The local records consisted of the official weather station at Cleveland Hopkins International Airport and six other gages which have records of varying periods. This data had been collected and arranged under prior contracts. The results are shown in Table B-2-1 for depths and intensities for various durations and frequencies. Table B-2-2 shows rainfall depths for 1 day through 10 day durations as interpolated from U.S.W.B. Bulletin 49.

TABLE B-2-1

RAINFALL DEPTHS AND INTENSITIES

Maximum Depths for Various Durations (inches)

Frequency	15 Min.	30 Min.	1 Hr.	2 Hr.	4 Hr.	6 Hr.	12 Hr.*
6 Months	.47	.56	.66	.82	.86	.90	-
1 Year	.60	.78	.90	1.04	1.08	1.14	1.70
3 Years	.86	1.10	1.30	1.46	1.50	1.58	-
5 Years	.99	1.28	1.50	1.66	1.70	1.80	2.70
10 Years	1.13	1.55	1.80	2.10	2.20	2.30	3.0

Maximum Intensities for Various Durations (in./hr.)

6 Months	1.87	1.12	.66	.42	.22	.15
1 Year	2.42	1.56	.90	.52	.27	.19
3 Years	3.42	2.20	1.30	.73	.37	.26
5 Years	3.96	2.56	1.50	.83	.42	.30
10 Years	4.52	3.10	1.80	1.05	.55	.38

*Depths for 12 hr. duration were obtained from U.S.W.B. Bulletin 40.

TABLE B-2-2

RAINFALL DEPTHS FOR LONG DURATIONS

Frequency	Duration (Days) 1	2	4	7	10
1 Year	2.15				
2 Year	2.40	2.7	3.4	3.7	4.1
5 Year	3.00	3.3	3.8	4.5	5.0
10 Year	3.40	3.8	4.3	5.0	5.7

Areal distribution was accounted for in the hydrograph development by ratios of overall area rainfall to the maximum point rainfall. The rainfall data was all based on point rainfall records. The following table shows the ratios that were compiled from several sources as well as by Havens and Emerson for the Cleveland area.

TABLE B-2-3

RATIO OF OVERALL AREA RATE TO MAXIMUM POINT RAINFALL

Area/Duration	30 Min. (Marston)	60 Min. (Marston)	6 Hr. (H & E)
Point Rainfall	1.0	1.0	1.0
1,000 Acres	0.90	0.95	-
2,000 Acres	0.85	0.93	0.97
4,000 Acres	0.80	0.88	0.96
8,000 Acres	0.75	0.85	0.93
10,000 Acres	-	-	0.92
20,000 Acres	-	-	0.87

After consulting with the contract officer, a separate document was prepared on the selection of the design storm. This document is attached as Appendix A.

3. Drainage Criteria - For all 162 drainage districts, the basic data was gathered. This consisted of measuring the total area, the area of open space and the length and slope of the drainage course. This data has been put in tabular form on work sheets and is attached as Appendix B.

The average sizes of the drainge districts were:

	Average (acres)	Range (acres)
Cuyahoga	3200	340 - 23774
Rocky	2700	266 - 8145
Chagrin	1850	460 - 4440
Lake Erie Direct	7000	2800 - 23396

All measurements were made on the work maps - USGS 1:24000.

4. Runoff Factors - With the techniques chosen to develop hydrographs, it was necessary to determine the imperviousness of each drainage district. This imperviousness factor was then used to compute the runoff factor. This computation is discussed in the section on hydrographs. The imperviousness factors were based on several in-field measurements in selected areas which were in turn compared to aerial photographs. For areas where recent aerial photographs were not available, comparisons were made to USGS maps and local street maps.

As many of these areas develop the imperviousness factors will increase. In order to project this change, some typical drainage districts were selected and synthetically urbanized as a function of the projected populations. Homes were increased at a rate equal to the growth rate per decade. For example, in one selected area there were 948 homes and the 1970-1980 growth ratio was 1.4 making the estimated number of homes in 1980 as 1,327. Roads were increased by the same rate. An additional imperviousness percentage was added to account for an increase in commercial buildings, schools, parking lots and industrial buildings. This percentage ranged from 2 to 6 percent.

Each drainage district was then individually compared to the selected examples and the imperviousness factor selected. The land use maps were used as a guide but several factors were considered, such as distance from central cities, highway systems, present trends of development, and topography. The areas were done independently by two people and reviewed by a third to reduce judgmental bias.

This information has been prepared in tabular form by decade and is attached in work sheet form as Appendix C.

5. Hydrographs - A generalized unit graph was developed using the results of gaging data from 21% of the urban area. This data was gathered under previous studies, and the individual watersheds were analyzed separately. A unit graph for each was developed using stream gaging data and rainfall data gathered over a period of about two years. The unit graphs were compared and correlated to arrive at a general or average unit graph with the shape and geometric dimensions as shown on Figure B-5-1.

Peak flow rates of available unit hydrographs were plotted in a curve that shows the relation between peak flow rates and drainage area and is shown on Figure B-5-2. The equation for this curve was computed as:

$$Y_3 = 15 + \frac{235}{DA} - \frac{80}{DA^2}$$

Where Y_3 = unit hydrograph peak - cfs/1,000 acres
DA = Drainage area - acres

This equation was used to compute the peak flow (Y_3).

Knowing Y_3, the area under the unit graph which represents 1" of runoff, and the geometric dimensions in terms of Y_3 and X_3 can be computed. Since the runoff volume is a function of the drainage area, the equation can be related to drainage area by the following equation:

$$X_3 = \cdot \frac{2122\ DA}{Y_3}$$

After computing Y_3 and X_3, other points of the unit hydrograph were calculated by utilizing ratios shown on Figure B-5-1. Computed unit hydrographs compared closely with available graphs - See Fig. B-5-3.

This average unit graph was, in turn, used to predict hydrographs of the individual areas for various rainfalls. Figures B-5-4 and B-5-5 show the results of this general unit graph verification.

A six-hour design storm was selected at various frequencies including: 6 months, 1-year, 3-year and 5-year. The storm duration was divided into 15-minute rainfall periods and the most intensive 8 periods were used eliminating periods

at the beginning and end of the storm with rainfall depth of .01-inch.

The rainfall excess was computed according to the following equation:

$$DE = C \times \text{Imp. Ratio} \times DT + \text{Perv. Ratio} (DT-DL)$$

Where DE = Depth of excess rainfall
C = Coeff. of runoff from impervious areas
DT = Total depth of rainfall in 15-minute period
DL = Depth of rainfall lost by infiltration. This depth was computed by an equation to account for intensity and duration of rainfall.

Excess rainfall from eight 15-minute rainfall periods was applied to the unit hydrograph previously described and the total hydrograph for each design storm was computed. These computed hydrographs were compared with available hydrographs of five drainage areas. Peak flows and volume checked closely.

Using this technique and the data described in Sections 2, 3 and 4, hydrographs for the 162 drainage districts were computed. The hydrographs for the 1-year storm are assembled by river basin presented in Appendix D.

Appendix E lists the available supplemental data for the hydrographs for the 5, 10 and 100 year storms.

Appendix D consists of 163 pages of computer output sheets and Appendix E consists of 326 pages of output sheets. Due to the massiveness of this data, it has not been included in this report but will be available upon request to interested parties.

GEOMETRIC RATIOS OF GENERAL UNIT HYDROGRAPH

$\frac{X_2}{X_3}$	$\frac{X_4}{X_3}$	$\frac{X_5}{X_3}$	$\frac{X_6}{X_3}$	$\frac{Y_2}{Y_3}$	$\frac{Y_4}{Y_3}$	$\frac{Y_5}{Y_3}$
0.45	1.84	3.64	9.43	0.14	0.40	0.16

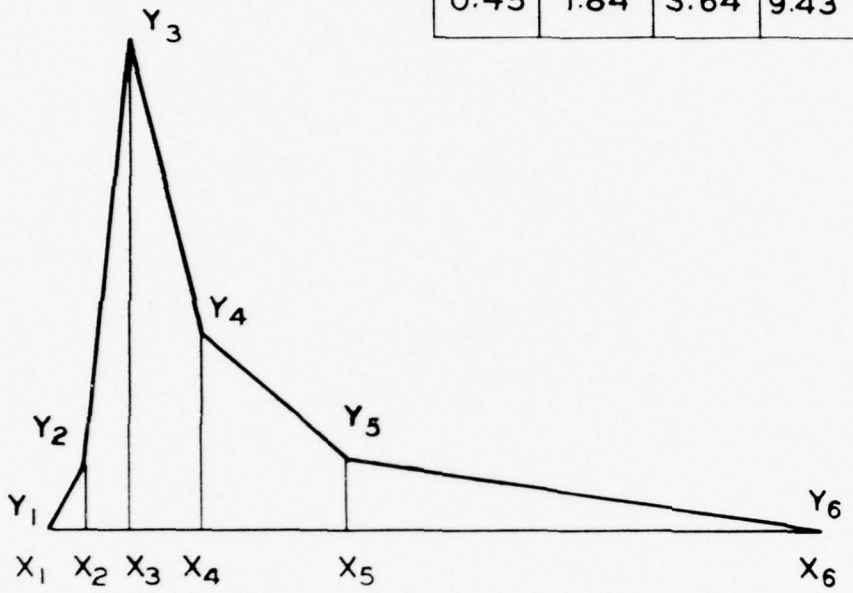
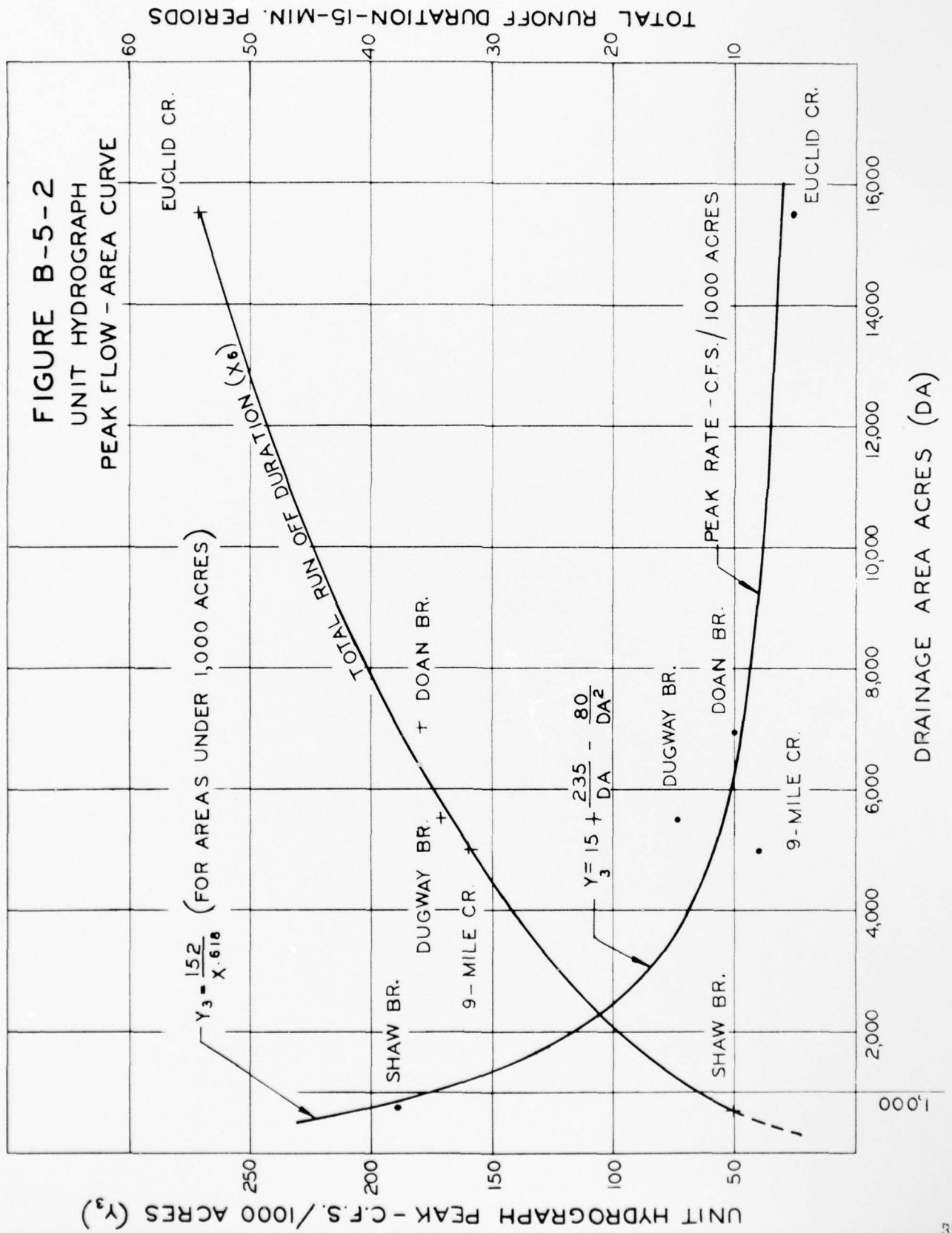


FIGURE B–5–1
GENERAL UNIT HYDROGRAPH

The next reach to the confluence with the East Branch is a high



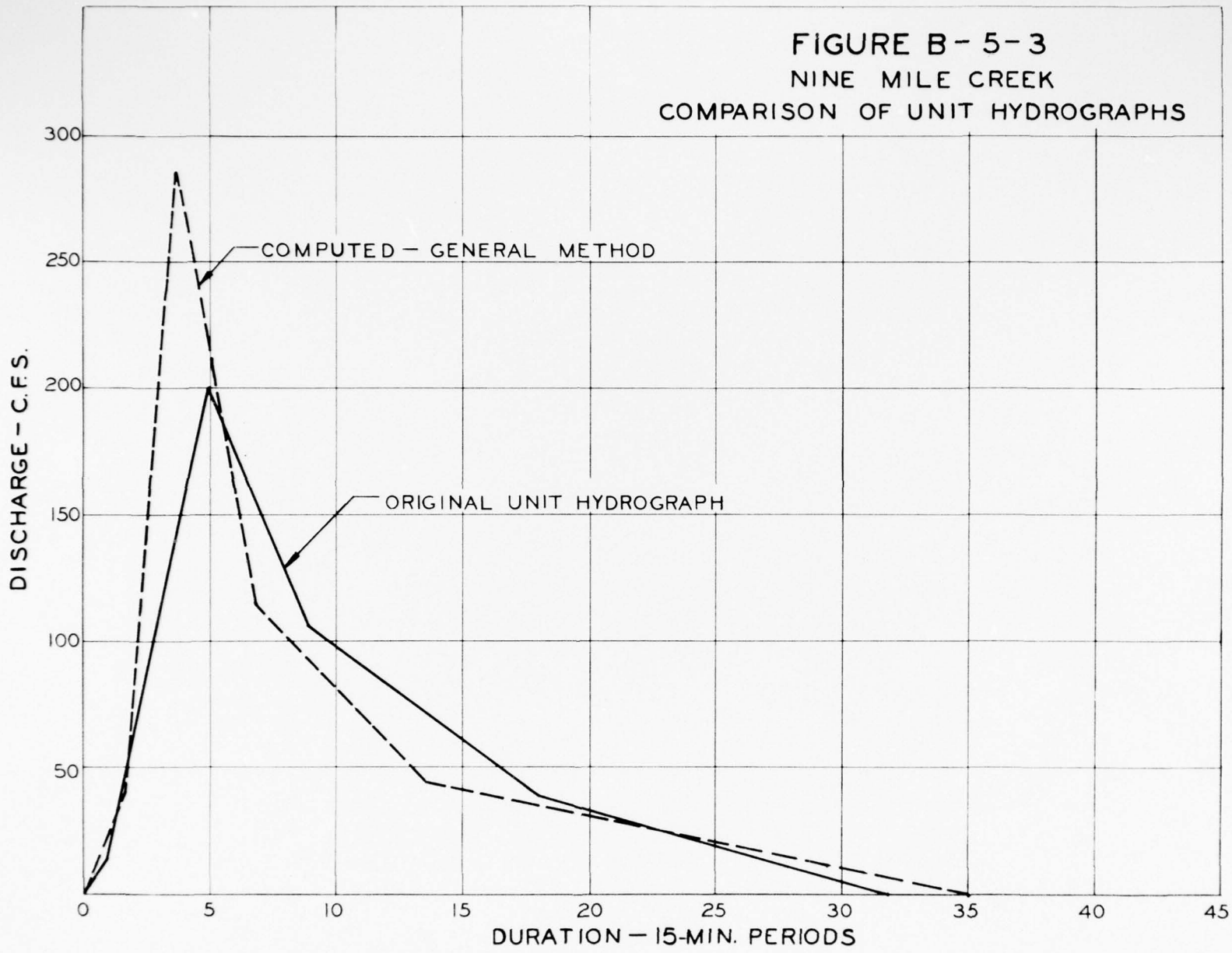


FIGURE B-5-3
NINE MILE CREEK
COMPARISON OF UNIT HYDROGRAPHS
COMPUTED - GENERAL METHOD
ORIGINAL UNIT HYDROGRAPH
DISCHARGE - C.F.S.
300
250
200
150
100
50
0
5
10
15
20
25
30
35
40
45
DURATION - 15-MIN. PERIODS

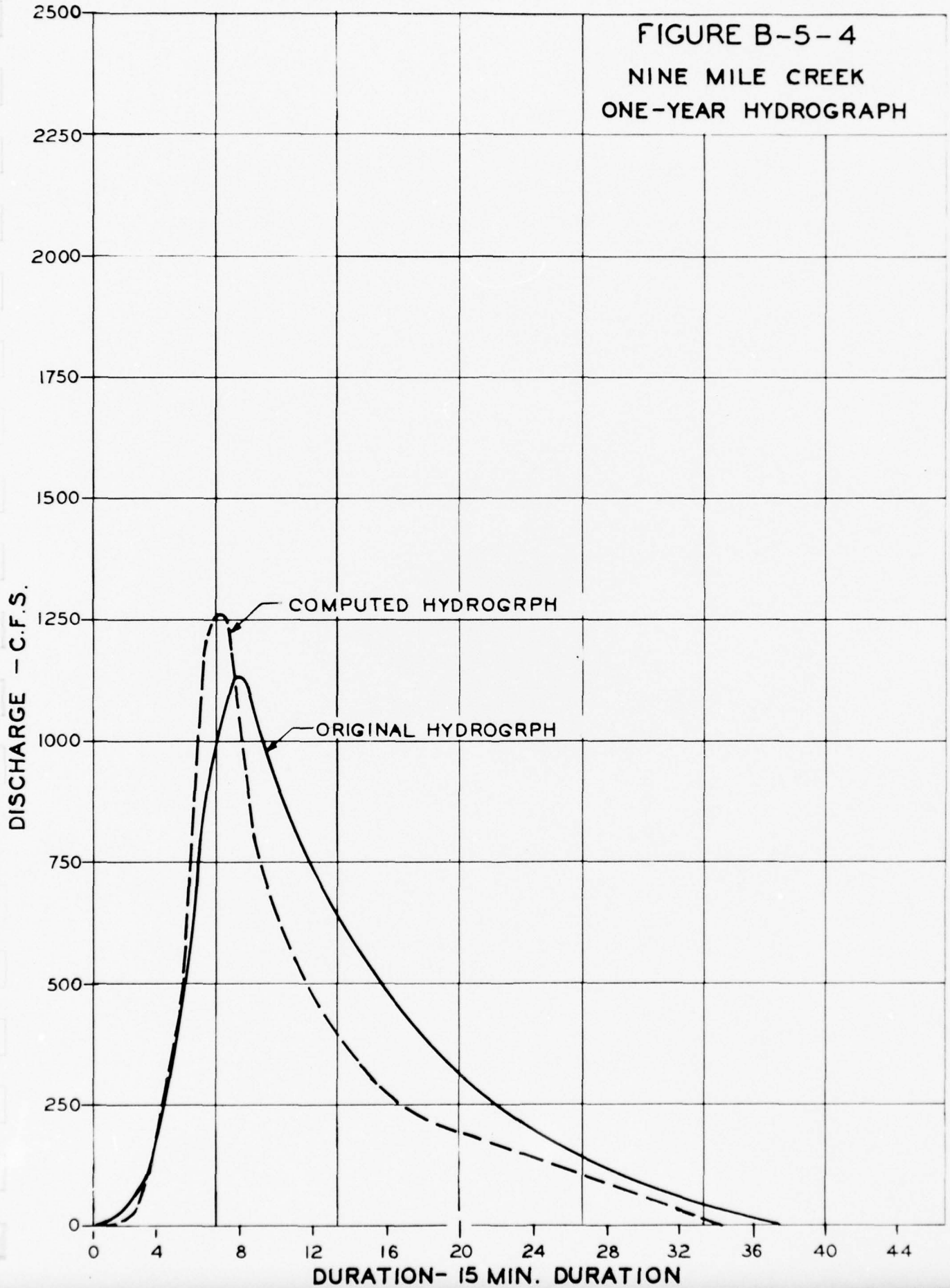
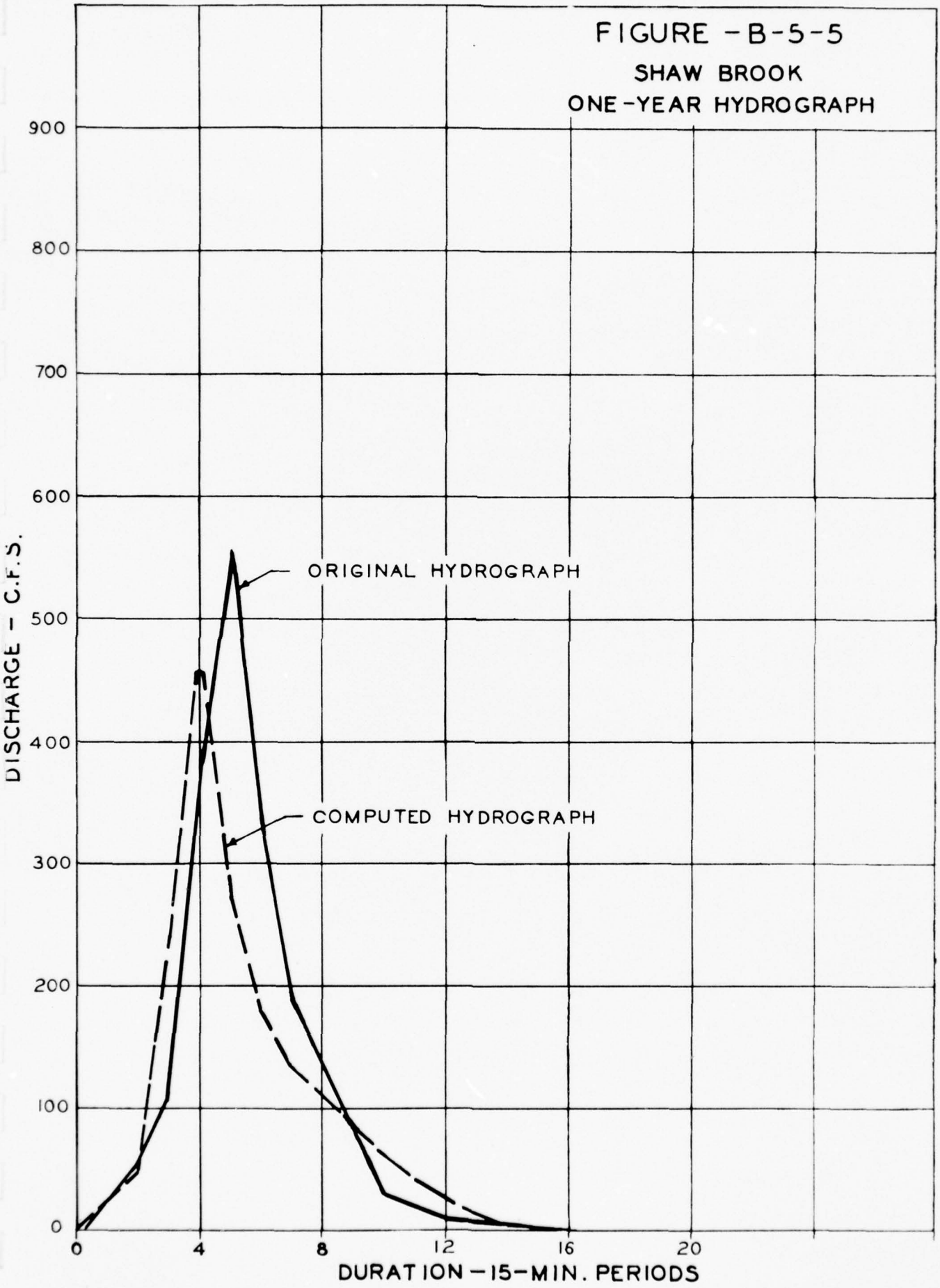


FIGURE B-5-4
NINE MILE CREEK
ONE-YEAR HYDROGRAPH
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
DISCHARGE - C.F.S.
COMPUTED HYDROGRPH
ORIGINAL HYDROGRPH
0
4
8
12
16
20
24
28
32
36
40
44
DURATION- 15 MIN. DURATION

FIGURE - B-5-5

SHAW BROOK
ONE-YEAR HYDROGRAPH



6. Urban Stormwater Runoff

Stormwater runoff from urban areas contribute significant pollution loads to Lake Erie. In an attempt to quantify these loads, the study area drainage areas were categorized as either a combined sewer overflow or separate system to account for the higher pollution concentrations resulting from the combined sewer overflow.

Table B-6-1, lists the pollution concentrations of the combined sewer overflows.

Table B-6-2, lists the pollution concentrations of the separate system urban stormwater runoff. These concentrations vary as the percent imperviousness varies. This is due to the fact that the degree of urbanization effects the character of the stormwater runoff.

Data for Tables B-6-1 and B-6-2 came from several sources including work done in the Cleveland Area. The data on the quality of combined sewer overflow varies greatly and the data in Table B-6-1 is weighted in favor of the Cleveland data.

A search of the literature was made to provide basic data on pollution loads in stormwater. The amount of data available is not great. When data on both the concentration and flow rate were available, it was converted to a percentage of the runoff duration versus percentage of the peak concentration for that runoff. By plotting them together, a graph was developed that relates concentration to discharge which is shown on Figure B-6-1 and has been termed a pollutograph.

Using the pollutograph, peak concentrations were selected for three types of areas: rural, urban and dense urban. Averages were computed for the same areas which are shown in Table B-6-2. In reviewing the literature, several problems were encountered that would cause the data to be inconsistent. These are listed below:

1. The sampling time did not extend past the basin lag time which means most of the samples were collected before the peak discharge occurred and the lower concentration of suspended solids at the end of the runoff are not reflected.
2. The suspended solids 10-15 times the volatile suspended solids and 30-150 times the BOD concentrations indicate the suspended solids are probably inert silts.
3. Suspended solids tests were often run with a glass fiber matt and with concentrations as high as those reported the aliquots were undoubtedly very small.
4. Low BOD-COD ratios in many cases probably indicate the BOD analysis was not done with an acclimated seed.
5. No mention of preceeding storm events or time between storm events.
6. No correlation with air pollution.

Table B-6-3 summarizes the Urban Stormwater Runoff pollutant loads for the study area by decade. This data was generated using the weighted average value of the percent imperviousness of each watershed. These weighted averages are presented in Table B-6-4. The results from this procedure were about 5% less than the actual sum of the individual districts.

TABLE B-6-1

COMBINED SEWER OVERFLOW CHARACTERISTICS

Suspended Solids	200 mg/l
BOD	60 mg/l
COD	220 mg/l
Total Volatile Solids	160 mg/l
Suspended Volatile Solids	120 mg/l
Phosphorus as P	8 mg/l
Nitrogen as N	12 mg/l
Chlorides	161 mg/l

TABLE B-6-2

SEPARATE SYSTEM STORMWATER RUNOFF CHARACTERISTICS

	Rural	Urban	Dense Urban
Imperviousness	5%	25%	55%
Suspended Solids	200 mg/l	300 mg/l	500 mg/l
BOD	3 mg/l	20 mg/l	30 mg/l
COD	50 mg/l	150 mg/l	200 mg/l
Total Volatile Solids	35 mg/l	110 mg/l	140 mg/l
Suspended Volatile Solids	25 mg/l	80 mg/l	105 mg/l
Phosphorus as P	.2 mg/l	.7 mg/l	.5 mg/l
Nitrogen as N	2.0 mg/l	3.1 mg/l	2.2 mg/l
Chlorides	60 mg/l	160 mg/l	166 mg/l

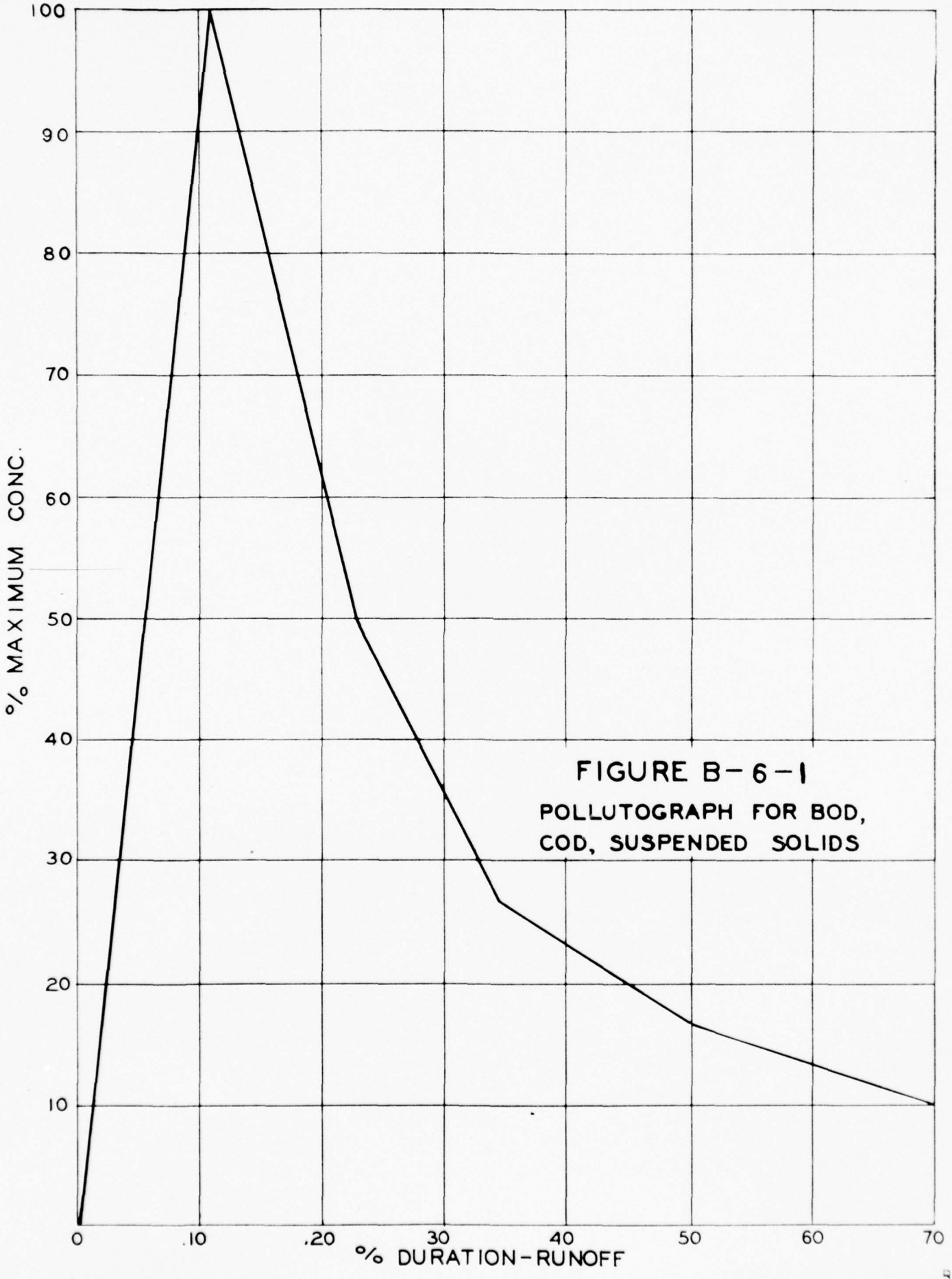


FIGURE B-6-1

POLLUTOGRAPH FOR BOD, COD, SUSPENDED SOLIDS

TABLE B-6-3

URBAN STORMWATER RUNOFF

		1970	1980	1990	2000	
Area (Acres)	Lake Erie	72,443	77,741	77,741	77,741	
	Cuyahoga	111,574	160,379	218,778	259,983	
	Rocky	28,686	38,730	81,823	94,472	
	Chagrin	12,340	16,880	37,890	63,140	
	TOTAL	225,043	293,730	416,232	495,336	
Volume (mg/Year)	Lake Erie	13,357	14,460	15,000	15,950	
	Cuyahoga	17,220	24,300	32,690	39,260	
	Rocky	3,438	4,881	10,221	12,311	
	Chagrin	1,440	2,050	4,660	7,850	
	TOTAL	35,455	45,691	62,571	75,371	
Suspended Solids (Lbs/Year)	Lake Erie	27,185,363	31,502,380	34,225,280	38,638,000	42
	Cuyahoga	35,878,560	52,556,330	73,645,360	92,339,288	102
	Rocky	6,918,186	10,507,961	22,087,191	28,426,851	33
	Chagrin	2,802,790	4,198,720	9,806,680	16,956,950	19
	TOTAL	72,784,900	98,765,400	139,764,500	176,361,000	197
Biochemical Oxygen Demand (Lbs/Year)	Lake Erie	4,688,306	5,018,750	5,244,620	5,504,980	5
	Cuyahoga	4,529,580	5,616,180	6,963,610	8,365,418	9
	Rocky	259,089	457,688	950,378	1,397,728	1
	Chagrin	87,530	154,340	386,780	713,630	
	TOTAL	9,564,000	11,247,000	13,545,000	15,982,000	18
Chemical Oxygen Demand (Lbs/Year)	Lake Erie	20,434,397	22,729,360	23,900,970	25,598,080	26
	Cuyahoga	22,096,920	29,605,340	39,221,110	48,685,430	55
	Rocky	2,356,512	3,893,747	8,166,157	11,337,397	14
	Chagrin	885,530	1,435,330	3,475,550	6,219,730	8
	TOTAL	45,773,000	57,664,000	74,764,000	91,841,000	105
Total Volatile Solids (Lbs/Year)	Lake Erie	14,885,383	16,571,560	17,374,560	18,550,760	19
	Cuyahoga	16,076,630	21,549,320	26,578,880	35,533,003	40
	Rocky	1,694,882	2,818,000	5,911,000	8,245,000	10
	Chagrin	634,000	1,034,000	2,509,000	4,501,000	5
	TOTAL	33,291,000	41,973,000	54,373,000	66,830,000	76
Suspended Volatile Solids (Lbs/Year)	Lake Erie	11,057,000	12,292,000	12,909,000	13,796,000	14
	Cuyahoga	11,877,000	15,865,000	20,983,000	26,056,000	29
	Rocky	1,225,000	2,040,000	4,279,000	5,979,000	7
	Chagrin	457,000	747,000	1,814,000	3,257,000	4
	TOTAL	24,616,000	30,944,000	39,985,000	49,088,000	56
Phosphorus as P (Lbs/Year)	Lake Erie	546,000	556,000	568,000	571,000	
	Cuyahoga	484,000	549,000	614,000	678,000	
	Rocky	13,000	20,000	39,000	54,000	
	Chagrin	4,000	6,000	15,000	28,000	
	TOTAL	1,047,000	1,131,000	1,236,000	1,331,000	1

TABLE B-6-3

RBAN STORMWATER RUNOFF

1990	2000	2010	2020
77,741	77,741	77,741	77,741
218,778	259,983	263,748	263,748
81,823	94,472	94,472	94,472
37,890	63,140	63,140	63,140
416,232	495,336	499,101	499,101
15,000	15,950	16,660	17,130
32,690	39,260	41,380	42,300
10,221	12,311	13,251	13,621
4,660	7,850	8,350	8,720
62,571	75,371	79,641	81,771
34,225,280	38,638,000	42,196,260	44,686,790
73,645,360	92,339,288	102,047,200	107,906,970
22,087,191	28,426,851	33,895,601	36,214,311
9,806,680	16,956,950	19,713,240	21,912,320
139,764,500	176,361,000	197,852,000	210,720,000
5,244,620	5,504,980	5,714,050	5,860,000
6,963,610	8,365,418	9,450,050	9,862,900
950,378	1,397,728	1,971,048	2,218,958
386,780	713,630	996,110	1,226,650
13,545,000	15,982,000	18,131,000	19,169,000
23,900,970	25,598,080	26,940,020	27,867,520
39,221,110	48,685,430	55,139,350	58,141,330
8,166,157	11,337,397	14,951,027	16,505,817
3,475,550	6,219,730	8,010,670	9,463,790
74,764,000	91,841,000	105,041,000	111,978,000
17,374,560	18,550,760	19,474,370	20,109,830
28,578,880	35,533,003	40,321,980	42,488,370
5,911,000	8,245,000	10,936,000	12,094,000
2,509,000	4,501,000	5,834,000	6,916,000
54,373,000	66,830,000	76,566,000	81,608,000
12,909,000	13,796,000	14,496,000	14,980,000
20,983,000	26,056,000	29,565,000	31,178,000
4,279,000	5,979,000	7,947,000	8,795,000
1,814,000	3,257,000	4,231,000	5,023,000
39,985,000	49,088,000	56,239,000	59,976,000
568,000	571,000	573,000	575,000
614,000	678,000	730,000	740,000
39,000	54,000	72,000	79,000
15,000	28,000	37,000	44,000
1,236,000	1,331,000	1,412,000	1,438,000

URBAN STORMWATER RUNOFF (Cont'd.)

		1970	1980	1990	2000
Nitrogen as N (Lbs/Year)	Lake Erie	912,000	948,000	967,000	982,000
	Cuyahoga	897,000	1,101,000	1,331,000	1,538,000
	Rocky	70,000	105,000	216,000	276,000
	Chagrin	27,000	41,000	95,000	163,000
	TOTAL	1,906,000	2,195,000	2,609,000	2,959,000
Chlorides (Lbs/Year)	Lake Erie	17,129,000	19,441,000	20,164,000	21,435,000
	Cuyahoga	19,806,000	27,645,000	37,818,000	47,693,000
	Rocky	2,630,000	4,295,000	9,033,000	12,402,000
	Chagrin	1,008,000	1,612,000	3,880,000	6,904,000
	TOTAL	40,573,000	52,993,000	70,895,000	88,434,000

RBAN STORMWATER RUNOFF (Cont'd.)

	1990	2000	2010	2020
)00	967,000	982,000	993,000	999,000
)00	1,331,000	1,538,000	1,658,000	1,689,000
)00	216,000	276,000	328,000	349,000
)00	95,000	163,000	189,000	210,000
)00	2,609,000	2,959,000	3,168,000	3,247,000
)00	20,164,000	21,435,000	22,388,000	23,024,000
)00	37,818,000	47,693,000	54,176,000	56,808,000
)00	9,033,000	12,402,000	16,126,000	17,726,000
)00	3,880,000	6,904,000	8,753,000	10,250,000
)00	70,895,000	88,434,000	101,443,000	107,808,000

TABLE B-6-4

PERCENT IMPERVIOUSNESS
(Weighted Average)

	1970	1980	1990	2000	2010	2020
Chargin River Watershed						
Separate Systems	6	7	10	14	18	21
Combined Systems	-	-	-	-	-	-
Rocky River Watershed						
Separate Systems	7	9	13	17	22	24
Combined Systems	25	30	30	30	30	30
Cuyahoga River Watershed						
Separate Systems	10	13	17	21	24	26
Combined Systems	38	41	43	45	47	47
Lake Erie Watershed						
Separate Systems	20	26	30	34	37	39
Combined Systems	46	46	47	47	47	47

7. Rural Stormwater Runoff

Although the stormwater runoff pollution loads from a rural area are low as compared to an urban area of equal size, the total load from rural land in the study is significant due to the large amount of land in the category. Table B-7-1 shows land usage for the study area.

Table B-7-2 shows the concentrations of the waste constituents used for rural stormwater runoff. It is noted that these are the same as urban stormwater runoff of low percent imperviousness.

Table B-7-3 summarizes the annual rural stormwater pollution loads by decade for each of the watersheds in the study area.

TABLE B-7-1

RURAL AND URBAN AREAS

	ACRES					
	1970	1980	1990	2000	2010	2020
CUYAHOGA RIVER WATERSHED						
Urban	111,600	160,400	218,800	260,000	263,800	263,800
Developable Rural*	152,200	103,400	45,000	3,800	0	0
Rural	256,600	256,600	256,600	256,600	256,600	256,600
ROCKY RIVER WATERSHED						
Urban	28,700	38,700	81,800	94,500	94,500	94,500
Developable Rural	65,800	55,700	12,700	0	0	0
Rural	93,700	93,700	93,700	93,700	93,700	93,700
CHAGRIN RIVER WATERSHED						
Urban	12,300	16,900	37,900	63,100	63,100	63,100
Developable Rural	50,800	46,300	25,200	0	0	0
Rural	107,600	107,600	107,600	107,600	107,600	107,600
LAKE ERIE						
Urban	72,400	77,700	77,700	77,700	77,700	77,700
Developable Rural	5,300	0	0	0	0	0
Rural	7,400	7,400	7,400	7,400	7,400	7,400

*Developable urban is defined as that land which is rural but will be developed into an urban area, according to the land use maps, by 2020.

TABLE B-7-2

RURAL STORMWATER RUNOFF

Suspended Solids	200 mg/l
B.O.D.	3 mg/l
C.O.D.	50 mg/l
Total Volatile Solids	35 mg/l
Suspended Volatile Solids	25 mg/l
Phosphorus as P	.2 mg/l
Nitrogen as N	2.0 mg/l
Chlorides	60 mg/l

TABLE B-7-3

RURAL STORMWATER RUNOFF

		1970	1980	1990	2000
Area (Acres)	Lake Erie	12,700	7,400	7,400	7,400
	Cuyahoga	408,800	360,000	301,600	260,400
	Rocky	159,500	149,400	106,400	93,700
	Chagrin	158,400	153,900	132,800	107,600
	TOTAL	739,400	670,700	548,200	464,100
Volume (Mill. Gal/Year)	Lake Erie	1,348	785	785	785
	Cuyahoga	43,500	38,310	32,090	27,710
	Rocky	16,970	15,900	11,310	9,970
	Chagrin	16,850	16,370	14,130	11,450
	TOTAL	78,668	71,365	58,315	49,915
Suspended Solids (1,000 Lbs/Year)	Lake Erie	2,307	1,343	1,343	1,343
	Cuyahoga	74,373	65,514	54,867	47,388
	Rocky	29,021	27,193	19,351	17,049
	Chagrin	28,830	28,003	24,180	19,585
	TOTAL	134,531	122,053	99,741	85,365
Biochemical Oxygen Demand (1,000 Lbs/Year)	Lake	36	21	21	21
	Cuyahoga	1,179	1,038	870	751
	Rocky	460	431	306	270
	Chagrin	457	443	383	310
	TOTAL	2,132	1,933	1,580	1,352
Chemical Oxygen Demand (1,000 Lbs/Year)	Lake Erie	563	328	328	328
	Cuyahoga	18,145	15,979	13,387	11,558
	Rocky	7,078	6,632	4,719	4,158
	Chagrin	7,032	6,830	5,897	4,777
	TOTAL	32,818	29,769	24,331	20,821
Total Volatile Solids (1,000 Lbs/Year)	Lake Erie	394	229	229	229
	Cuyahoga	12,702	11,186	9,371	8,091
	Rocky	4,954	4,642	3,303	2,910
	Chagrin	4,922	4,781	4,129	3,344
	TOTAL	22,972	20,838	17,032	14,574
Suspended Volatile Solids (1,000 Lbs/Year)	Lake Erie	282	164	164	164
	Cuyahoga	9,073	7,990	6,694	5,780
	Rocky	3,539	3,316	2,360	2,079
	Chagrin	3,515	3,415	2,948	2,388
	TOTAL	16,409	14,885	12,166	10,411
Phosphorus as P (1,000 Lbs/Year)	Lake Erie	2	1	1	1
	Cuyahoga	73	64	54	47
	Rocky	29	27	19	17
	Chagrin	28	27	23	19
	TOTAL	132	119	97	84

TABLE B-7-3

L STORMWATER RUNOFF

1990	2000	2010	2020
7,400	7,400	7,400	7,400
301,600	260,400	256,600	256,600
106,400	93,700	93,700	93,700
132,800	107,600	107,600	107,600
548,200	464,100	465,300	465,300
785	785	785	785
32,090	27,710	27,310	27,310
11,310	9,970	9,970	9,970
14,130	11,450	11,450	11,450
58,315	49,915	49,515	49,515
1,343	1,343	1,343	1,343
54,867	47,388	46,703	46,703
19,351	17,049	17,049	17,049
24,180	19,585	19,585	19,585
99,741	85,365	84,680	84,680
21	21	21	21
870	751	740	740
306	270	270	270
383	310	310	310
1,580	1,352	1,341	1,341
328	328	328	328
13,387	11,558	11,391	11,391
4,719	4,158	4,158	4,158
5,897	4,777	4,777	4,777
24,331	20,821	20,654	20,654
229	229	229	229
9,371	8,091	7,974	7,974
3,303	2,910	2,910	2,910
4,129	3,344	3,344	3,344
17,032	14,574	14,457	14,457
164	164	164	164
6,694	5,780	5,696	5,696
2,360	2,079	2,079	2,079
2,948	2,388	2,388	2,388
12,166	10,411	10,327	10,327
1	1	1	1
54	47	46	46
19	17	17	17
23	19	19	19
97	84	83	83

2

RURAL STORMWATER RUNOFF (Cont'd.)

		1970	1980	1990	2000
Nitrogen as N (1,000 Lbs/Year)	Lake Erie	22	13	13	13
	Cuyahoga	726	640	536	463
	Rocky	283	265	188	166
	Chagrin	281	273	236	191
	TOTAL	1,312	1,191	973	833
Chlorides (1,000 Lbs/Year)	Lake Erie	675	393	393	393
	Cuyahoga	21,774	19,175	16,064	13,870
	Rocky	8,494	7,959	5,664	4,990
	Chagrin	8,438	8,196	7,077	5,732
	TOTAL	39,381	35,723	29,198	24,985

AL STORMWATER RUNOFF (Cont'd.)

1990	2000	2010	2020
13	13	13	13
536	463	456	456
188	166	166	166
236	191	191	191
973	833	826	826
393	393	393	393
16,064	13,870	13,669	13,669
5,664	4,990	4,990	4,990
7,077	5,732	5,732	5,732
29,198	24,985	24,784	24,784

APPENDIX A

SELECTION OF DESIGN STORM

The magnitude of the design storm that a given facility must treat obviously affects both the storage and treatment cost. In the feasibility study a one year design storm was chosen, since that is the design currently being used for all of design work in the Cleveland area at this time. It is the purpose of this portion of the Survey Scope study to review this decision and compare designs of 6 months, 1, 3, 5 and 10 years.

The question to answer is - what is the economic and environmental impact of having a storm greater than the design storm occur? In order to compare volumes of runoff treated under certain design conditions, Table 1 was prepared to show the ratios, of the runoff from a 6 month, 1, 3, 5 or 10 year rainfall to the capacity of a storage treatment facility of various design sizes. Each design situation has a ratio of 1.00 when the frequency of a storm matches the design storm chosen to compute the volume of the storage basin.

To further compare these volumes, Table 2 has been prepared to show the efficiency of stormwater collection and treatment for various storms with different designs. Table 2 shows the percentage of total annual runoff time when the storage and treatment capacity is exceeded by a runoff resulting from a storm with a frequency greater than that used for the design. Figure 1 shows the reverse, that is, the percentage of total annual volume treated under the different storm occurrences and design schemes. It is important to note that the capacity is exceeded at the later part of a storm runoff occurrence and after the high concentrations that are normally associated with the first flush have occurred. Further, it should be noted these percentages will only occur once in the period of frequency. For example, if the facility is designed for the one year storm and a rainfall equal to the 10 year occurrence happens, then from Figure 1, 90% of the total annual volume would be treated. The other 10% would receive treatment, but the capacity of the facility would be exceeded hydraulically

and the degree of treatment would be reduced. Again this would only occur once in 10 years. However, within a 10 year period several rainfalls may occur which would exceed the one year frequency used for design, such as the 5 year, 3 year, 2 year, etc. To illustrate this, a period of record was chosen arbitrarily from 1950 to 1967, and a detailed analysis of the rainfall data was done. The results are shown in Table 3.

From Table 3, it can be shown that in a 16 year period only 2.7% of the runoff exceeded the design value. This is equivalent to 1.7% in a 10 year period of all accumulated runoff exceeding the 1 year runoff.

Costs were computed on typical areas for storage and treatment facilities with various design storm criteria. These costs were reduced to a cost per acre value and compared to the suspended solids removal achieved. This data is shown on Figure 2. Three treatment schemes were considered:

Scheme A would be the situation where land is available for earth storage lagoons.

Scheme B would be the situation when land is expensive and not available in tracts large enough for Scheme A. Storage would be in concrete storage tanks.

Scheme C would be the situation when no land is available for storage and treatment would have to be designed for the peak flow without storage.

Figure 3 compares the percent removal to cost per acre and cost per percent removal. The treatment technique for the three schemes in Figure 2 and Figure 3 is screening followed by sedimentation, microstraining and ozonation. The detention time in the sedimentation basin is two days. A polymer would be used to hasten sedimentation also. Figure 4 compares the percentage increase in cost to percentage increase in treatment.

Using this data, the design storm for the storage and treatment was

selected. The criteria for the collection system is governed by drainage and flooding constraints rather than pollution constraints. Generally, the collection systems were designed to handle a 5 to 10 year storm consistent with the usual engineering practices.

Referring to these graphs, it can be seen that for a storm water treatment design greater than one year the cost start to rise sharply. The 3, 5 and 10 year designs cost substantially more than the 6 month or 1 year; consequently the choice was then reduced to either the 6 month or 1 year design. When the actual rainfall data is reviewed in Table 3, it shows that the 6 month storm was exceeded 35 times in the 16.5 year period. If the one year design storm is compared to the actual data, it is noted to have been exceeded 17 times. Likewise, the 3 year storm was exceeded 5 times. Statistically, this is expected.

Again referring to Figure 4, it is seen that the cost to increase from a 6 month design to a one year design is about 11% for Scheme A which is the most commonly encountered scheme. This same increase also reduces the number of times the facility design is exceeded by fifty percent. Further, using the one year design will provide greater margin for the inevitable inconsistencies in rainfall occurrences.

After considering these facts, the 1 year design storm was selected for the survey scope study.

TABLE 1

Frequency of a Given Storm	Ratio of Runoff From Given Storm to Capacity Provided by a Design Storm of:				
	6 Month Design	1 Year Design	3 Year Design	5 Year Design	10 Year Design
6 Months	1.00	0.68	0.42	0.36	0.25
1 Year	1.47	1.00	0.62	0.52	0.36
3 Years	2.38	1.62	1.00	0.85	0.58
5 Years	2.82	1.92	1.18	1.00	0.69
10 Years	4.06	2.76	1.72	1.45	1.00

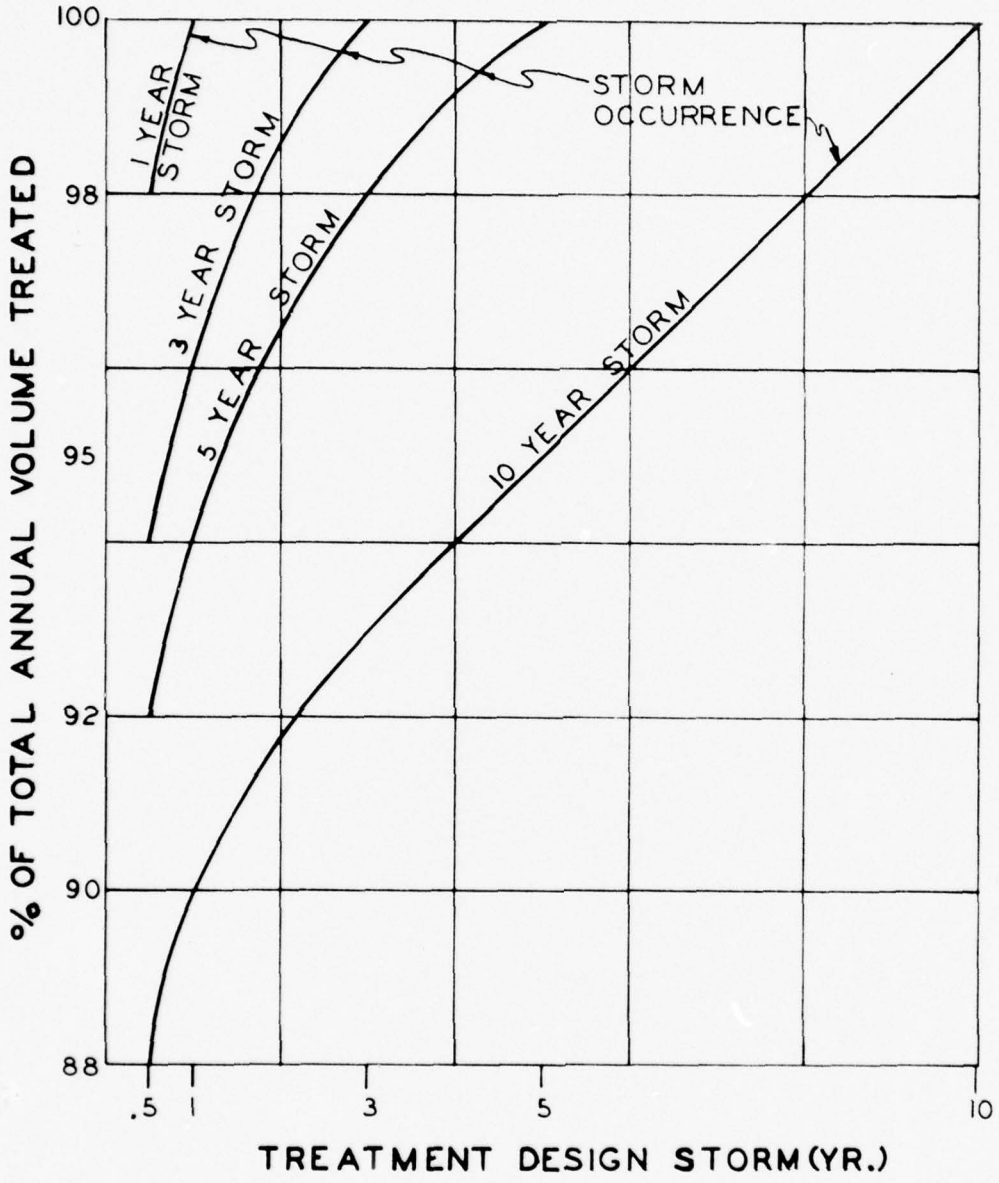
TABLE 2

Frequency of a Given Storm	Percentage of Total Annual Runoff Time When Treatment Capacity is Exceeded by Runoff From Storm of Given Frequency				
	6 Month Design	1 Year Design	3 Year Design	5 Year Design	10 Year Design
6 Months	0	0	0	0	0
1 Year	2%	0	0	0	0
3 Years	6%	4%	0	0	0
5 Years	8%	6%	2%	0	0
10 Years	12%	10%	7%	5%	0

TABLE 3

AMOUNT OF RUNOFF EXCEEDING STORAGE CAPACITY OF VARIOUS DESIGN STORM FREQUENCIES OVER THE PERIOD 1950-1967

(1) Design Storm	(2) Number of Rainfall Events Exceeding the Design Storm In the Period	(3) Total Rainfall Depth Resulting From These Events	(4) Total Runoff Resulting From These Events	(5) Total Runoff From All Events During Period	(4/5) Total Runoff Exceeding Design Storm Total Runoff in 16 Years
6 mo.	35	15.05	5.57	126.5	4.4%
1 yr.	17	7.80	3.42	126.5	2.7%
3 yr.	5	3.20	1.63	126.5	1.3%
5 yr.	3	2.40	1.27	126.5	1.0%
10 yr.	1	1.12	0.66	126.5	0.5%



EXAMPLE: 5 YEAR STORM
& 1 YEAR STORM FACILITY
RESULT: 94% OF TOTAL
ANNUAL VOLUME TREATED

HAVENS AND EMERSON LTD.

FIG. 1

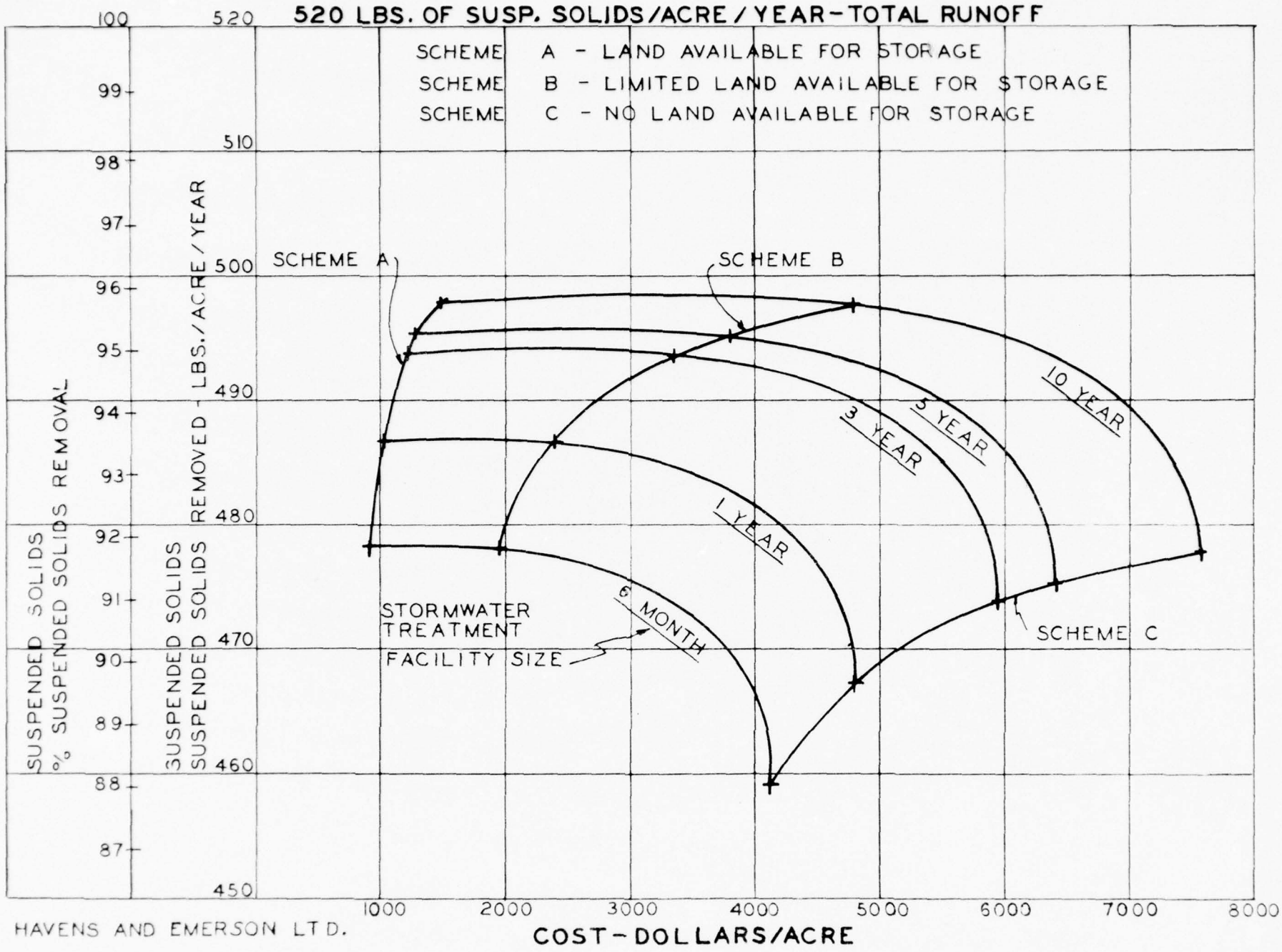
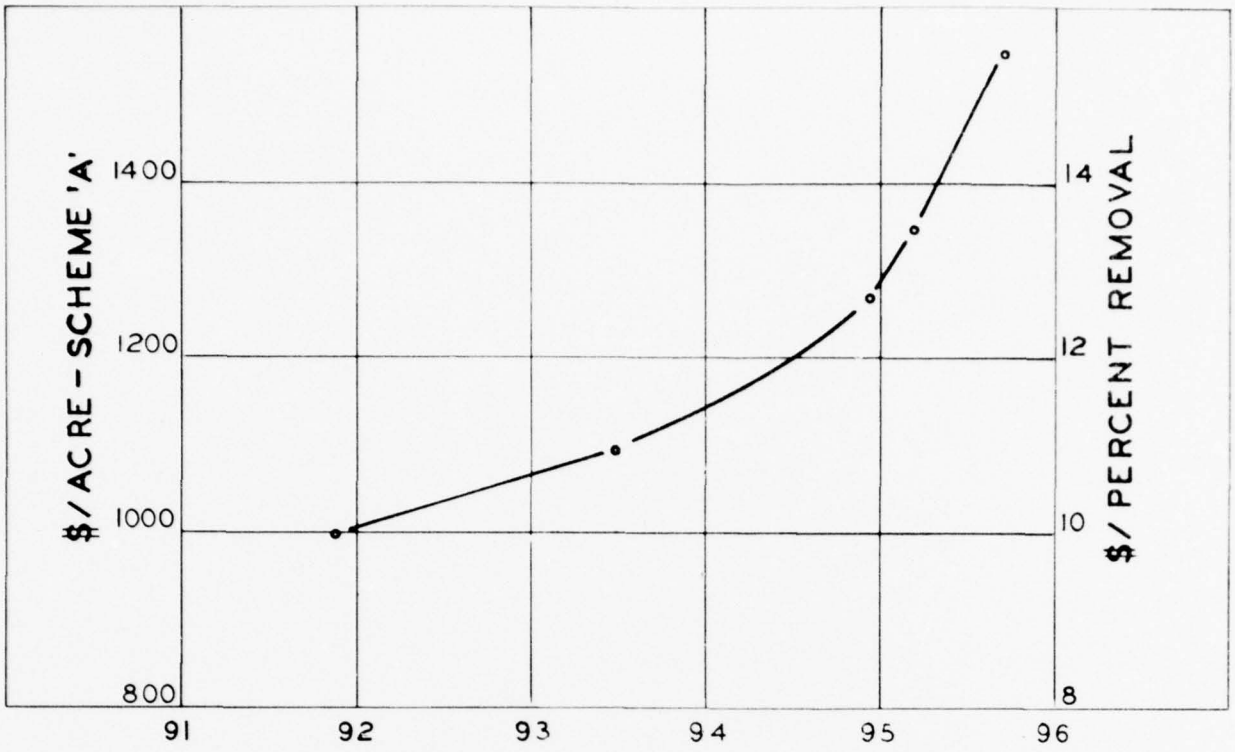
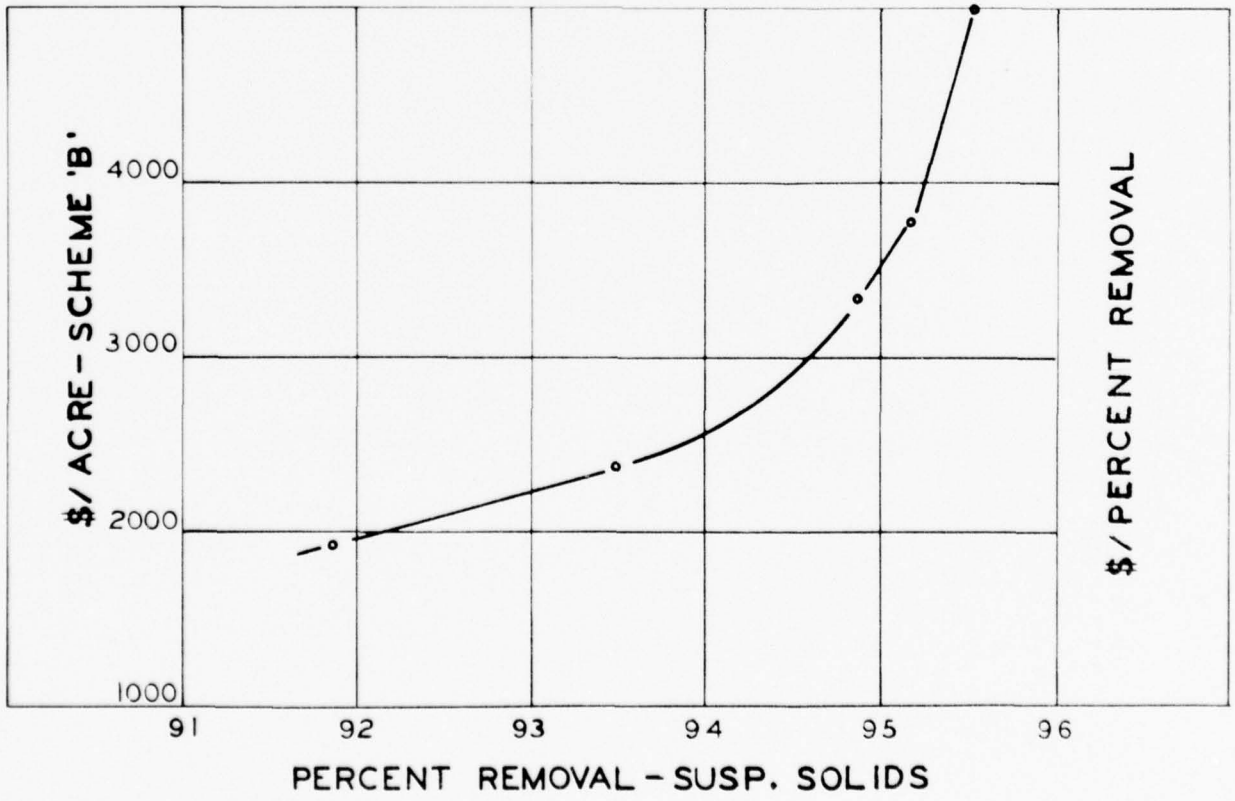


FIG. 2

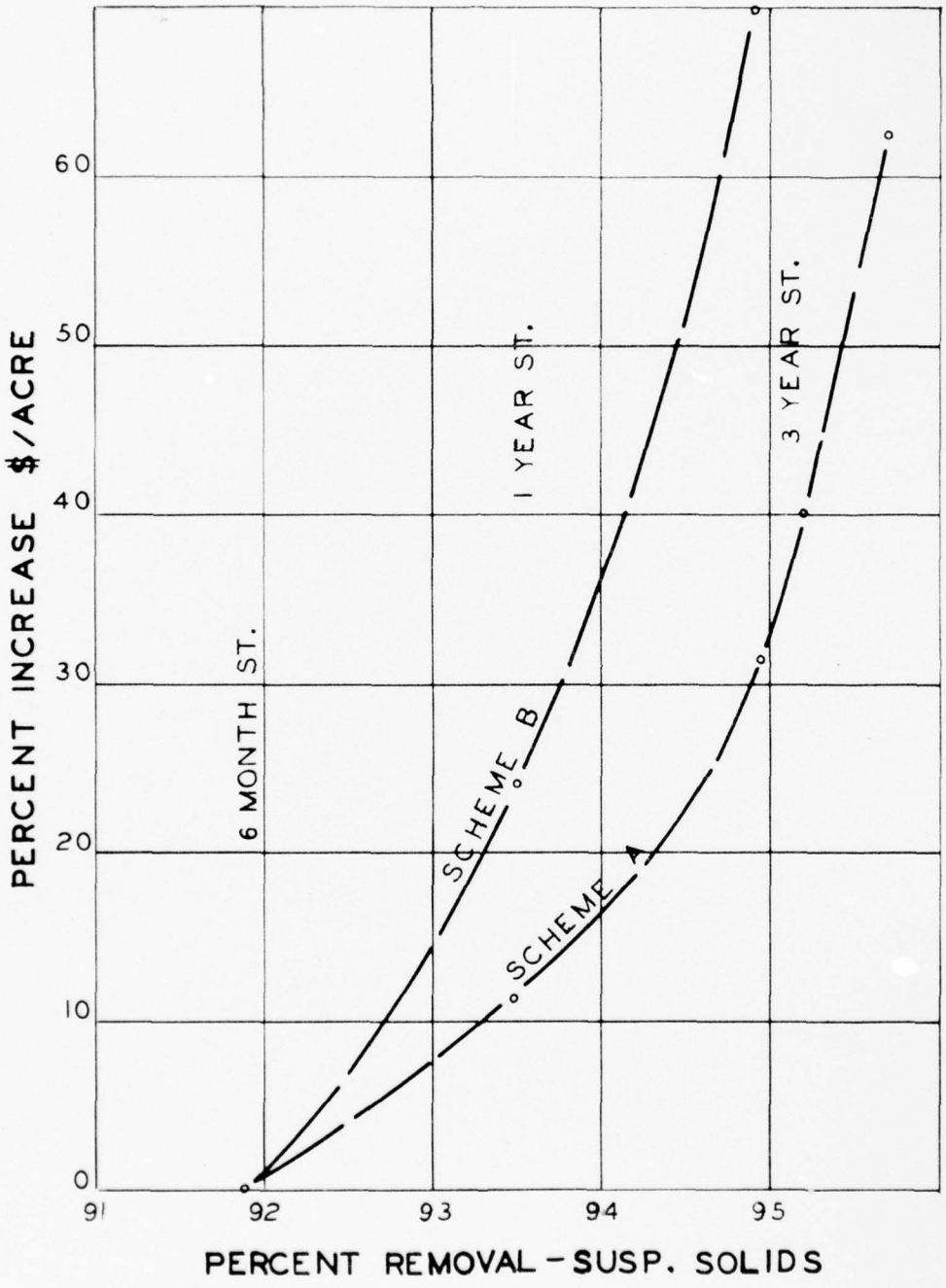
HAVENS AND EMERSON LTD.





HAVENS AND EMERSON LTD.

FIG. 3



HAVENS AND EMERSON LTD.

FIG. 4

APPENDIX B

DRAINAGE AREAS CHARACTERISTICS

ROCKY RIVER WATERSHED

Area Designation	Total Area (Acres)	Open Space Area (Acres)	% Area to be Developed	Length of Channel (Ft.)	Channel Slope Ft./Mile
R-1	716	0	100	(4,500)	23.46
R-2	3,994	0	100	20,000	13.20
R-3	2,112	0	100	21,000	27.65
R-4	845	0	100	(4,500)	58.66
R-5	872	0	100	4,000	92.4
R-6	3,434	0	100	17,000	18.63
R-7	2,222	0	100	15,000	24.64
R-8	2,544	0	100	8,000	33.0
R-9	266	0	100	4,000	26.40
R-10	6,437	275	96	30,000	31.68
R-11	3,921	0	100	30,000	10.56
R-12	7,484	0	100	40,000	48.84
R-13	7,466	368	96	40,000	46.20
R-14	1,120	0	100	12,000	61.6
R-15	918	0	100	8,000	79.20
R-16	2,213	0	100	15,000	116.16
R-17	1,285	0	100	11,000	148.80
R-18	3,471	0	100	22,000	33.60
R-19	3,177	0	100	15,000	8.80
R-20	4,187	0	100	11,000	52.80
R-21	532	0	100	9,000	76.26
R-22	2,185	321	86	18,000	85.06
R-23	5,197	0	100	26,000	57.87
R-24	3,140	184	95	26,000	56.86

APPENDIX B (Cont'd.)

DRAINAGE AREAS CHARACTERISTICS

ROCKY RIVER WATERSHED

Area Designation	Total Area (Acres)	Open Space Area (Acres)	% Area to be Developed	Length of Channel (Ft.)	Channel Slope Ft./Mile
R-25	3,155	0	100	27,000	70.40
R-26	762	0	100	7,000	52.80
R-27	2,480	0	100	28,000	60.34
R-28	8,145	0	100	30,000	18.48
R-29	2,553	0	100	14,000	113.14
R-30	1,423	0	100	15,000	65.12
R-31	780	0	100	15,000	52.80
R-32	313	275	92	22,000	38.40
R-33	799	0	100	6,000	158.40
R-34	1,588	0	100	22,000	33.60
R-35	2,736	0	100	18,000	29.33

LAKE ERIE WATERSHED

LE-1	4,362	0	100	20,600	30.75
LE-2	3,232	130	96	6,600	49.60
LE-3	5,758	280	95	7,400	0
LE-4	15,444	1,080	93	55,800	55.35
LE-5	23,396	0	92	41,200	59.59
LE-6	4,980	0	92	10,000	0
LE-7	3,958	0	100	8,600	0
LE-8	2,800	0	100	7,500	0
LE-9	3,398	0	100	12,000	52.8
LE-10	5,115	0	100	23,000	34.43
LE-11	5,298	0	100	33,000	17.6

APPENDIX B (Cont'd.)

DRAINAGE AREAS CHARACTERISTICS

CUYAHOGA RIVER WATERSHED

Area Designation	Total Area (Acres)	Open Space Area (Acres)	% Area to be Developed	Length of Channel (Ft.)	Channel Slope Ft./Mile
CU-1	2,472	0	100	12,000	30.80
CU-2	4,684	0	100	36,000	77.73
CU-3	3,562	0	100	21,000	82.97
CU-4	23,770	0	100	76,000	37.51
CU-5	12,654	0	100	52,000	51.78
CU-6	3,995	138	97	26,000	38.58
CU-7	4,527	872	81	34,000	43.48
CU-8	8,870	780	92	42,000	72.91
CU-9	1,698	643	63	8,000	191.4
CU-10	1,846	460	76	10,000	147.84
CU-11	2,370	184	93	14,000	82.97
CU-12	340	0	100	7,000	75.42
CU-13	4,500	0	100	28,000	41.48
CU-14	3,425	698	80	18,000	152.53
CU-15	652	184	72	7,000	98.05
CU-16	1,791	165	91	14,000	82.97
CU-17	1,368	0	100	5,000	78.20
CU-18	551	0	100	4,000	26.4
CU-19	5,730	0	100	23,000	73.46
CU-20	1,515	0	100	15,000	95.04
CU-21	2,057	450	79	14,500	196.63
CU-22	1,386	643	54	12,000	171.60
CU-23	1,240	0	100	3,000	35.2
CU-24	3,388	0	100	17,000	62.1
CU-25	4,472	0	100	23,000	18.36

APPENDIX B (Cont'd.)

DRAINAGE AREAS CHARACTERISTICS

CUYAHOGA RIVER WATERSHED

Area Designation	Total Area (Acres)	Open Space Area (Acres)	% Area to be Developed	Length of Channel (Ft.)	Channel Slope Ft./Mile
CU-26	1,221	0	100	10,000	58.00
CU-27	2,874	0	100	6,000	112.20
CU-28	1,634	0	100	11,000	72.0
CU-29	5,914	1,534	75	24,000	11.00
CU-30	1,974	0	100	11,000	52.80
CU-31	1,586	184	89	15,000	56.32
CU-32	2,020	0	100	14,000	128.22
CU-33	1,230	0	100	8,500	62.11
CU-34	2,507	0	100	11,000	12.00
CU-35	11,175	2,507	78	39,000	13.53
CU-36	3,186	0	100	6,000	79.20
CU-37	3,039	0	100	9,000	70.40
CU-38	2,121	0	100	8,500	99.38
CU-39	3,884	0	100	16,000	49.50
CU-40	863	184	79	11,000	120.00
CU-41	1,130	285	75	11,000	153.60
CU-42	1,625	0	100	13,000	77.16
CU-43	3,765	2,635	30	11,400	34.7
CU-44	3,094	464	85	18,000	10.6
CU-45	3,976	0	100	21,000	28.9
CU-46	1,616	0	100	20,400	47.9
CU-47	7,833	1,560	80	38,000	49.3
CU-48	1,625	0	100	10,000	66.0
CU-49	1,304	130	90	8,400	69.1
CU-50	8,228	0	100	35,700	16.3

APPENDIX B (Cont'd.)

DRAINAGE AREAS CHARACTERISTICS

CUYAHOGA RIVER WATERSHED

Area Designation	Total Area (Acres)	Open Space Area (Acres)	% Area to be Developed	Length of Channel (Ft.)	Channel Slope Ft./Mile
CU-51	5,492	1,100	80	16,800	25.1
CU-52	1,882	94	95	12,600	3.4
CU-53	3,719	0	100	21,000	17.6
CU-54	3,526	350	90	13,200	52.80
CU-55	1,900	0	100	15,000	7.0
CU-56	2,800	0	100	15,000	17.6
CU-57	1,965	200	90	8,000	69.3
CU-58	7,906	474	94	30,200	25.4
CU-59	2,249	0	100	10,000	63.4
CU-60	2,534	0	100	2,000	158.4
CU-61	3,223	0	100	6,000	88
CU-62	3,150	0	100	23,000	50.5
CU-63	1,423	0	100	11,200	4.7
CU-64	3,324	0	100	8,000	33
CU-65	661	0	100	6,000	114.4
CU-66	3,085	0	100	11,800	53.7
CU-67	2,608	0	100	20,000	22.5
CU-68	1,905	0	100	9,000	70.4
CU-69	1,914	570	70	6,000	17.6
CU-70	6,327	0	100	29,000	24.6
CU-71	2,681	0	100	16,200	29.3
CU-73	1,056	0	100	10,000	79.20
CU-74	1,864	642	66	15,000	49.28
CU-75	2,663	321	88	18,000	23.46

APPENDIX B (Cont'd.)

DRAINAGE AREAS CHARACTERISTICS

CUYAHOGA RIVER WATERSHED

Area Designation	Total Area (Acres)	Open Space Area (Acres)	% Area to be Developed	Length of Channel (Ft.)	Channel Slope Ft./Mile
CU-76	872	137	85	9,000	52.8
CU-77	2,000	367	82	12,000	57.20
CU-78	3,250	734	78	23,000	34.43
CU-79	1,360	275	80	8,000	79.2
CU-81	486	0	100	5,000	42.24
CU-82	551	0	100	3,000	158.4
CU-83	835	0	100	5,000	95.5
CU-84	677	0	100	4,000	238

CHAGRIN RIVER WATERSHED

CHN-1	2,070	550	74	13,000	20
CHN-2	7,140	1,100	85	29,000	21.8
CHN-3	3,310	370	89	26,000	44.7
CHN-4	1,360	230	84	16,000	135.3
CHN-5	2,460	830	67	16,000	135.3
CHN-6	2,440	0	100	22,000	103.2
CHN-7	690	140	80	6,000	255.2
CHN-8	1,110	0	100	6,000	264.0
CHN-9	1,440	500	66	14,000	98.0
CHN-10	3,130	780	76	13,000	138.1
CHN-11	3,750	1,700	55	15,000	140.8
CHN-12	1,590	410	75	11,000	67.2
CHN-13	2,440	690	72	13,000	97.47
CHN-16	1,600	0	100	10,000	58.1
CHN-17	1,330	0	100	13,000	60.9

APPENDIX B (Cont'd.)

DRAINAGE AREAS CHARACTERISTICS

CHAGRIN RIVER WATERSHED

Area Designation	Total Area (Acres)	Open Space Area (Acres)	% Area to be Developed	Length of Channel (Ft.)	Channel Slope Ft./Mile
CHN-18	640	0	100	4,500	152.5
CHN-19	710	0	100	5,000	95.0
CHN-20	690	230	67	7,000	113.1
CHN-21	460	0	100	4,000	171.6
CHN-22	740	60	92	6,500	146.2
CHN-23	1,230	0	100	6,000	184.8
CHN-24	2,760	0	100	17,000	40.4
CHN-25	2,400	640	74	15,000	70.4
CHN-26	1,910	370	81	14,000	113.1
CHN-27	2,670	320	89	12,000	105.6
CHN-28	2,150	0	100	14,000	83.0
CHN-29	660	0	100	8,000	66.0
CHN-30	1,070	0	100	5,000	116.2
CHN-31	1,580	340	79	13,000	40.6
CHN-32	890	0	100	3,000	88.0
CHN-33	910	0	100	6,000	70.40
CHN-34	770	0	100	10,000	37.0
CHN-35	1,340	447	67	16,000	13.2
CHN-36	2,520	840	67	10,000	26.8

APPENDIX C

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

ROCKY RIVER WATERSHED

Area Designation	Area (Acres)	1970	1980	1990	2000	2010	2020	*
R-1	716	40	45	45	45	45	45	2
R-2	3,994	10	15	20	25	30	30	2
R-3	2,112	25	28	30	32	35	35	2
R-4	845	40	45	45	45	45	45	2
R-5	872	30	35	40	45	45	45	2
R-6	3,434	10	15	20	25	30	30	3
R-7	2,222	<10	10	15	20	25	25	3
R-8	2,544	15	18	20	25	30	30	2
R-9	266	25	30	30	30	30	30	1
R-10	6,437	12	15	17	20	25	28	2
R-11	3,921	<10	<10	10	12	15	20	3
R-12	7,484	<10	<10	10	15	20	25	3
R-13	7,466	10	15	20	25	30	30	3
R-14	1,120	<10	<10	10	15	20	25	3
R-15	918	<10	<10	10	15	20	25	3
R-16	2,213	<10	14	17	20	25	25	3
R-17	1,285	<10	14	17	20	25	25	3
R-18	3,471	<10	<10	10	15	20	25	3
R-19	3,177	<10	<10	<10	10	15	18	3
R-20	4,187	<10	<10	10	12	15	20	3
R-21	532	<10	<10	10	15	20	25	2
R-22	2,185	<10	<10	10	15	20	25	3

*Note: 1 = Combined
2 = Separate
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

ROCKY RIVER WATERSHED

Area Designation	Area (Acres)	1970	1980	1990	2000	2010	2020	*
R-23	5,197	<10	<10	10	15	17	20	3
R-24	3,140	<10	<10	10	15	20	25	3
R-25	3,155	<10	<10	<10	10	15	18	3
R-26	762	<10	<10	<10	10	12	15	3
R-27	2,480	<10	<10	10	15	17	20	3
R-28	8,145	<10	<10	10	15	20	25	3
R-29	2,553	<10	<10	<10	10	12	15	3
R-30	1,423	<10	<10	<10	10	12	15	3
R-31	780	<10	<10	<10	10	15	20	3
R-32	313	<10	<10	10	15	20	22	3
R-33	799	<10	<10	<10	10	12	15	3
R-34	1,588	<10	10	15	20	22	25	2
R-35	2,736	<10	10	15	20	22	25	2
Total	94,472 Acres 147.61 Sq. Mile							
Average Area	2,700 Acres							

LAKE ERIE WATERSHED

LE-1	4,362	27	30	35	40	45	45	2
LE-2	3,232	30	35	40	45	45	45	2
LE-3	5,758	30	35	40	45	45	45	2
LE-4	15,444	17	25	30	35	40	45	3
LE-5	23,396	44	45	45	45	45	45	1
LE-6	4,980	56	56	56	56	56	56	1

*Note: 1 = Combined
2 = Separate
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

LAKE ERIE WATERSHED

Area Designation	Area (Acres)	1970	1980	1990	2000	2010	2020	*
LE-7	3,958	47	47	50	50	50	50	1
LE-8	2,800	40	45	45	45	45	45	2
LE-9	3,398	25	30	35	35	35	35	2
LE-10	5,115	15	18	20	25	30	30	2
LE-11	5,298	<10	10	12	15	18	20	2
Total	77,741 Acres							
	121.47 Sq. Mile							
Average Area	7,067 Acres							

CUYAHOGA RIVER WATERSHED

CU-1	2,472	49	49	50	50	50	50	1
CU-2	4,684	47	47	50	50	50	50	1
CU-3	3,562	40	40	45	45	45	45	1
CU-4	23,770	29	35	37	40	45	45	2
CU-5	12,654	31	35	37	40	45	45	1
CU-6	3,995	12	17	25	30	35	35	2
CU-7	4,527	<10	10	15	20	25	30	3
CU-8	8,870	15	17	22	25	30	30	3
CU-9	1,698	<10	<10	<10	10	12	15	3
CU-10	1,846	<10	<10	10	12	15	20	3
CU-11	2,370	20	23	25	30	35	35	2
CU-12	340	20	23	25	30	35	35	2
CU-13	4,500	<10	10	15	20	25	30	2
CU-14	3,425	<10	14	17	20	25	25	3
CU-15	652	<10	<10	10	15	20	20	3

*Note: 1 = Combined
2 = Separate
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

CUYAHOGA RIVER WATERSHED

Area Designation	Area (Acres)	1970	1980	1990	2000	2010	2020	*
CU-16	1,791	<10	10	15	20	25	25	3
CU-17	1,368	<10	10	15	17	23	25	3
CU-18	551	<10	10	15	20	25	30	3
CU-19	5,730	<10	<10	10	15	20	25	3
CU-20	1,515	<10	14	17	20	25	25	3
CU-21	2,057	<10	<10	10	12	15	18	3
CU-22	1,386	<10	<10	10	12	15	18	3
CU-23	1,240	<10	10	10	15	20	22	3
CU-24	3,388	<10	10	15	20	25	25	3
CU-25	4,472	<10	10	15	20	25	25	3
CU-26	1,221	<10	10	15	17	23	25	3
CU-27	2,874	<10	10	15	20	25	25	2
CU-28	1,634	<10	<10	10	12	15	17	3
CU-29	5,914	<10	<10	<10	10	12	15	3
CU-30	1,974	<10	<10	<10	10	12	15	3
CU-31	1,586	<10	<10	<10	10	12	15	3
CU-32	2,020	<10	<10	10	15	20	20	3
CU-33	1,230	<10	10	15	20	25	25	3
CU-34	2,507	<10	<10	<10	10	15	18	3
CU-35	11,175	<10	<10	10	12	15	17	3
CU-36	3,186	<10	<10	<10	10	12	15	3
CU-37	3,039	<10	<10	<10	10	12	15	3
CU-38	2,121	<10	<10	<10	10	12	15	3
CU-39	3,884	<10	<10	10	12	15	17	3

*Note: 1 = Combined
2 = Separate
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

CUYAHOGA RIVER WATERSHED

Area Designation	Area (Acres)	1970	1980	1990	2000	2010	2020	*
CU-40	863	<10	<10	<10	10	12	15	3
CU-41	1,130	<10	<10	<10	10	12	15	3
CU-42	1,525	<10	<10	10	10	12	15	3
CU-43	3,765	<10	<10	<10	<10	10	10	3
CU-44	3,094	<10	<10	10	12	14	15	3
CU-45	3,976	<10	<10	10	12	14	15	3
CU-46	1,616	<10	<10	10	15	17	20	3
CU-47	7,833	<10	<10	10	15	17	20	3
CU-48	1,625	25	27	30	35	35	35	2
CU-49	1,304	<10	10	17	25	30	35	3
CU-50	8,228	<10	10	12	15	20	25	3
CU-51	5,492	10	15	17	20	25	30	2
CU-52	1,882	<10	10	15	25	25	30	3
CU-53	3,719	15	20	25	30	35	40	2
CU-54	3,526	18	20	25	30	30	30	3
CU-55	1,900	40	42	45	47	50	50	2
CU-56	2,800	20	25	30	40	45	45	2
CU-57	1,965	<10	<10	12	20	25	30	3
CU-58	7,906	<10	<10	10	12	15	17	3
CU-59	2,249	40	45	50	50	50	50	2
CU-60	2,534	45	50	50	50	50	50	1
CU-61	3,223	30	35	40	45	45	45	1
CU-62	3,150	15	23	32	40	40	40	2
CU-63	1,423	35	37	40	45	45	45	2

*Note: 1 = Combined
2 = Separate
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

CUYAHOGA RIVER WATERSHED

Area Designation	Area (Acres)	1970	1980	1990	2000	2010	2020	*
CU-64	3,324	50	50	50	50	50	50	1
CU-65	661	45	50	50	50	50	50	1
CU-66	3,085	15	23	32	40	40	40	2
CU-67	2,608	<10	10	15	20	25	30	3
CU-68	1,905	50	50	50	50	50	50	2
CU-69	1,914	15	20	25	35	35	35	2
CU-70	6,327	20	25	30	35	40	45	2
CU-71	2,681	<10	10	12	15	17	20	3
CU-73	1,056	<10	<10	<10	10	12	15	3
CU-74	1,864	<10	<10	<10	10	12	15	3
CU-75	2,663	<10	<10	<10	10	12	15	3
CU-76	872	<10	<10	<10	10	12	15	3
CU-77	2,000	<10	<10	<10	10	12	15	3
CU-78	3,250	<10	<10	<10	10	12	15	2
CU-79	1,360	<10	<10	<10	10	12	15	3
CU-81	486	<10	<10	<10	10	12	15	3
CU-82	551	<10	<10	<10	10	12	15	3
CU-83	835	<10	10	12	15	20	25	3
CU-84	677	<10	10	12	15	20	25	3

Total 262,175 Acres
409 Sq. Miles

Average Area 3,197 Acres

*Note: 1 = Combined
2 = Separate
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

CHAGRIN RIVER WATERSHED

Area Designation	Area (Acres)	1970	1980	1990	2000	2010	2020	*
CHN-1	2,070	20	23	27	30	35	35	2
CHN-2	7,140	10	15	20	25	30	35	3
CHN-3	3,310	<10	10	15	25	25	25	2
CHN-4	1,360	<10	<10	10	15	20	25	3
CHN-5	2,460	<10	<10	<10	10	15	18	3
CHN-6	2,440	<10	<10	10	15	20	25	3
CHN-7	690	<10	<10	10	15	20	20	3
CHN-8	1,110	<10	<10	10	10	15	15	3
CHN-9	1,440	<10	<10	10	15	20	25	3
CHN-10	3,130	10	15	20	25	25	25	3
CHN-11	3,750	<10	<10	<10	10	12	15	3
CHN-12	1,590	<10	<10	<10	10	15	17	3
CHN-13	2,440	<10	<10	10	13	17	20	3
CHN-16	1,600	<10	<10	10	12	15	18	3
CHN-17	1,330	<10	<10	10	12	15	18	3
CHN-18	640	<10	<10	<10	10	12	15	3
CHN-19	710	<10	<10	<10	10	12	15	3
CHN-20	690	<10	<10	<10	10	12	15	3
CHN-21	460	<10	<10	<10	10	12	15	3
CHN-22	740	<10	<10	<10	10	12	15	3
CHN-23	1,230	<10	10	10	15	20	25	2
CHN-24	2,760	<10	<10	<10	10	12	15	3
CHN-25	2,400	<10	<10	<10	10	12	15	3
CHN-26	1,910	<10	<10	<10	10	15	20	2
CHN-27	2,670	<10	<10	10	15	20	25	3

*Note: 1 = Combined
2 = Separate
3 = Natural Channel

APPENDIX C (Cont'd.)

DRAINAGE AREAS PERCENT IMPERVIOUSNESS BY DECADE

CHAGRIN RIVER WATERSHED

Area Designation	Area (Acres)	1970	1980	1990	2000	2010	2020	*
CHN-28	2,150	<10	<10	<10	10	12	15	3
CHN-29	660	<10	<10	<10	10	12	15	3
CHN-30	1,070	<10	<10	<10	10	12	15	3
CHN-31	1,580	<10	<10	<10	10	12	15	3
CHN-32	890	<10	<10	10	15	20	25	3
CHN-33	910	<10	<10	<10	10	12	15	3
CHN-34	770	<10	<10	<10	10	12	15	3
CHN-35	1,340	<10	<10	10	12	15	20	2
CHN-36	2,520	<10	<10	<10	10	12	15	3
Total	61,960 Acres 96 Sq. Miles							
Average Area	1,822 Acres							

*Note: 1 = Combined
2 = Separate
3 = Natural Channel

APPENDIX D

ONE YEAR STORM HYDROGRAPHS AND LOADS

This appendix has not been included because of its size. It will be available to interested parties. The original will be included with the submission of reports to the Buffalo District, Corps of Engineers.

APPENDIX E

SUPPLEMENTAL DATA

In the development of the stormwater alternatives, it became necessary to consider treatment of the 5, 10 and 100 year storm. Therefore, the computer program was used to generate the unit hydrographs for these storms for each of the 162 drainage districts.

This information was not reproduced due to the massiveness of the data and the fact that the 1 year storm was chosen for design purposes. The 1 year storm data is presented in Appendix D of this phase report.